January 10, 2018

Poly Met Mining, Inc. NPDES Antidegradation Review - Preliminary MPCA Determination

Antidegradation Procedures Overview

Poly Met Mining, Inc. (PolyMet) submitted an NPDES/SDS application for a proposed new discharge. Every NPDES permit authorizing a new NPDES discharge requires completion of antidegradation procedures. The purpose of an antidegradation review is to achieve and maintain the highest possible quality in surface Water of the State (Minn. R. 7050.0250). Antidegradation generally specifies three "tiers" of water quality protection:

- Tier 1 protection requires existing uses and the water quality necessary to support those uses to be maintained and protected – this protection is assured when all applicable water quality standards are met;
- Tier 2 protects existing high water quality, which is water quality that is better than that required by the standards necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water;
- Tier 3 requires the maintenance and protection of water quality necessary to preserve specific water resources of outstanding value.

The antidegradation procedures ensure that Tier 1 protection applies to all waters and standards and that Tier 2 and Tier 3 protection applies where applicable.

Generally applicable antidegradation standards and requirements are found in Minnesota Rules parts 7050.0250 to 7050.0335. Antidegradation standards for bioaccumulative chemicals of concern in the Lake Superior basin (Minnesota Rules 7052.0300 to 7052.0330) also apply. Antidegradation procedures require the permit applicant to prepare an antidegradation assessment or evaluation, and the MPCA to conduct an antidegradation review and make a determination as to whether the antidegradation standards are satisfied.

The antidegradation assessment and review compare projected future water quality (after a proposed new or increased discharge) to existing water quality. This comparison requires knowing the current authorized (as defined by an NPDES/SDS permit) loading of pollutants to the receiving water and projected future loading, and determining if there is a measurable change in water quality. If there is a measurable change, additional action must be taken – such as demonstrating that non-degrading alternatives have been investigated, that degradation is prudently and feasibly minimized, and that degradation is needed to allow for important economic and social development.

As noted in the rule record for the MPCA's recent antidegradation rulemaking, "wastewater treatment facilities must operate under a wide variety of conditions[,] which results in effluent pollutant load and concentration variability." (See Attachment 1 MPCA Detailed Responses to Comments, April 20, 2016, at 46). Therefore, until a new facility is operational, effluent and water quality concentrations can only be a best estimate. Once a facility is permitted, the level of pollution authorized by the permit becomes the baseline for any future antidegradation review.

Any proposals for future changes to the facility must be evaluated to determine if the changes would result in a net increase in loading or other causes of degradation. When a proposal is for new effluent limits because of a new water quality standard or better monitoring data, but those limits are not the result of changes to pollutant loading, antidegradation procedures are not required (see Minn. R. 7050.0255, subp. 26). If a net increase in loading would occur, antidegradation procedures are required and the review begins to look at changes in water quality and proceeds through the rest of the antidegradation procedures.

Summary

PolyMet's Antidegradation Evaluation sought to satisfy the applicable requirements of the rules in both Minn. R. 7050 and Minn. R. 7052. The full Antidegradation Evaluation including tables, figures and appendices discussed in the write-up below can be found in Appendix A of Volume III of the NPDES/SDS application which can be found as Attachment 1 to this document and at the following link: <Link>. PolyMet's Antidegradation Evaluation provided the Minnesota Pollution Control Agency (MPCA) with the necessary information to conduct an Antidegradation review.

PolyMet's Antidegradation Evaluation and MPCA's subsequent review demonstrate that water quality degradation caused by the proposed project cannot be avoided, but will be prudently and feasibly minimized, existing and beneficial uses will be protected, and the proposed activity is necessary to accommodate important economic or social changes in the geographic area in which degradation of existing high water quality is expected. The proposed project will implement the best technology in practice and treatment. Therefore, the MPCA has made a preliminary determination that the project will satisfy antidegradation standards in Minnesota Rules 7050.0265, 7052.0300, and 7052.0330.

While the project will cause degradation for some water quality parameters, the project will also cut off movement of existing polluted groundwater associated with former LTVSMC tailings basin. As a result, the headwaters of Second Creek, Trimble Creek, and Unnamed Creek will experience an improvement in water quality for sulfate and salty parameters.

Background

The project's proposed discharge location is in the headwater areas of Trimble Creek, Unnamed Creek (tributaries to the Embarrass River) and Second Creek (tributary to the Partridge River) in the St. Louis River watershed. The immediate receiving waters for the discharges in the Embarrass River watershed are wetlands which are class 2D, 3D, 4C, 5 and 6 waters. These wetlands drain to Trimble and Unnamed Creeks which are class 2B, 3C, 4A, 4B, 5 and 6 waters. The immediate receiving water for the discharge in the Partridge River watershed is Second Creek, which is a class 2B, 3C, 4A, 4B, 5 and 6 water. All the above-identified waters are located in the Lake Superior basin and are classified as Outstanding International Resource Waters (OIRWs). The nearest downstream restricted Outstanding Resource Value Water (ORVW) – a water where a new discharge is not allowed until there is no prudent or feasible alternative - is Lake Superior. There are no prohibited ORVWs – waters where a new discharge is not allowed – downstream of the project.

Under the antidegradation requirements, all existing uses of each water must be maintained ("tier 1" protection). For the purposes of assuring protective antidegradation requirements, all downstream waters were evaluated by MPCA for Class 2 standards as waters "of high quality" on a parameter-by-parameter basis as defined in Minn. R. 7050.0255 subp. 21. This ensures that the antidegradation procedures provide "tier 2" protection. "Tier 2" protection prohibits the lowering of high water quality unless such resulting water quality is necessary to accommodate important economic or social changes in the geographic area in which degradation of existing high water quality is anticipated. The antidegradation procedures also considered "tier 3" protection for OIRWs and ORVWs. "Tier 3" protection requires that the exceptional characteristics of outstanding resource waters be maintained. The antidegradation procedures for this project also includes mercury, the only bioaccumulative chemical of concern for the Lake Superior basin under Minn. R. 7052.0300 that is present in the proposed discharge.

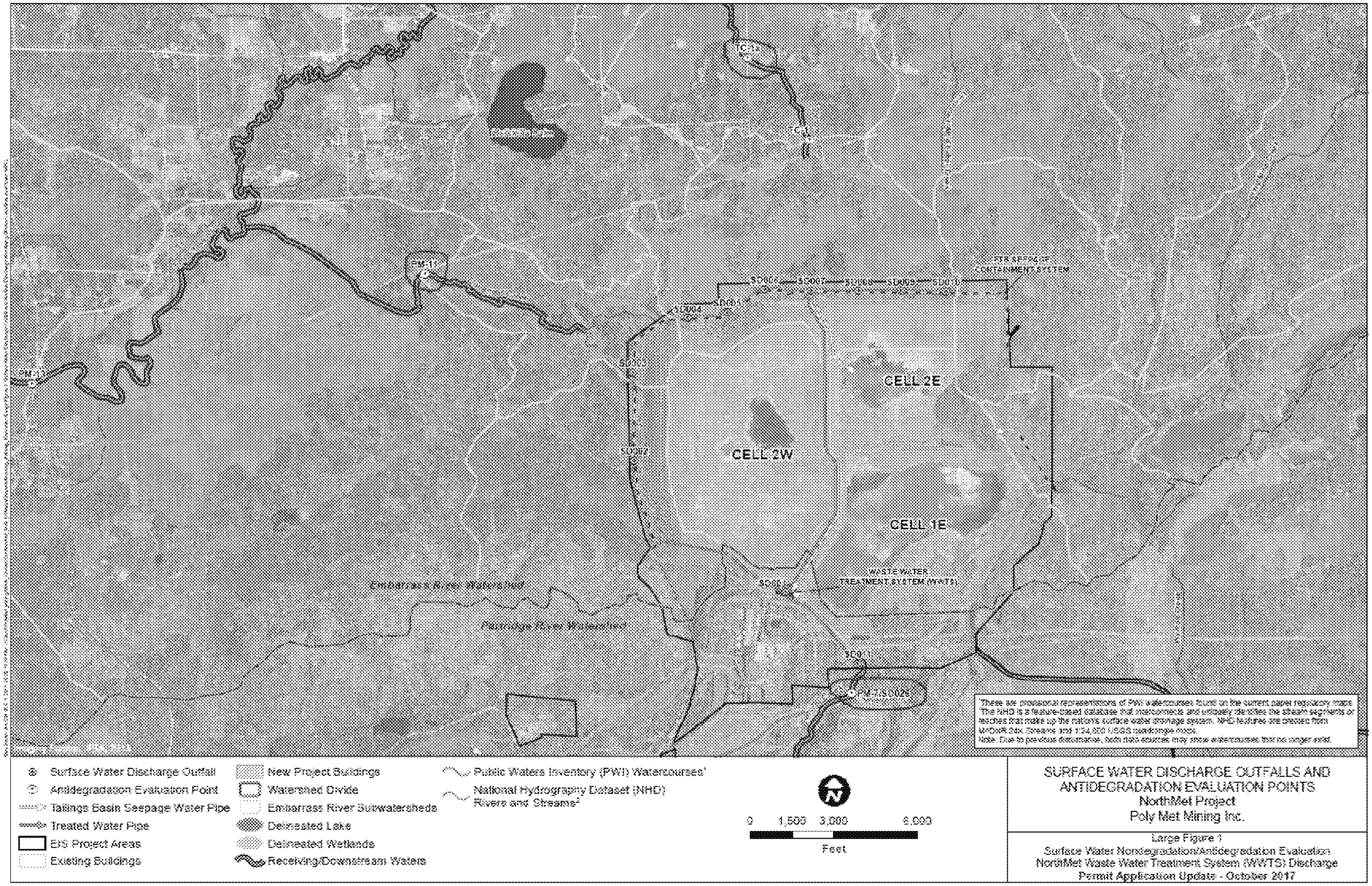
Low flow receiving water conditions represent the period when point sources have the greatest potential to impact receiving water quality. Minnesota Rule 7053.0195, subpart 7, requires control of pollutants from point source dischargers to ensure water quality standards are maintained at specified minimum stream flows. For all parameters of concern for this proposed discharge, the receiving water flow rate required to be protected for is the 7Q10. The 7Q10 is the lowest 7-day average flow that is expected to occur once every 10 years. In this review, the protective receiving water 7Q10 flow rate for all discharge locations is 0.0 CFS because of the headwaters nature of the site location. A 0.0 CFS receiving water flow rate does not allow for any assimilative dilution of discharged pollutants.

The MPCA chose to evaluate surface water degradation at three locations (TC-1a, PM-7/SD026 & PM-11; Map 1 below). These locations had adequate data to determine the existing water quality. The MPCA determined that if degradation was minimized at these three locations, then degradation would also be minimized for all other downstream waters.

Outfall SD001 will be monitored for effluent water quality for compliance at the point of discharge from the wastewater treatment system (WWTS). The effluent is then distributed to three separate headwater receiving water bodies (Unnamed Creek wetlands, Trimble Creek wetlands, and Second Creek), via outfalls SD002 – SD011. Unnamed Creek is characterized by the data from monitoring location PM-11. Trimble Creek is characterized by the data from monitoring location TC-1a. Second Creek is characterized by the data from monitoring location SD026/PM-7. The treated effluent will be distributed to wetlands in the headwaters area of Unnamed Creek on the west side of the FTB via outfalls SD002 and SD003. Treated effluent will be distributed to wetlands to the north of the FTB to the headwaters area of Trimble Creek via outfalls SD004 – SD010. Treated effluent will be distributed directly to Second Creek via outfall SD011.

The remainder of this document summarizes the process of MPCA's review of PolyMet's Antidegradation Evaluation, then demonstrates compliance with each subpart of the applicable antidegradation regulations included in Minn. R. 7050.0265. The rule language of each subpart is followed by MPCA's assessment of how the Antidegradation Evaluation submitted by PolyMet addressed each requirement.

Map 1. Antidegradation evaluation locations used by PolyMet. The locations circled in red are the locations used by the MPCA in this analysis.



Summary of Antidegradation Procedures Process and Definitions

A summary of the antidegradation procedures process is provided in flow chart 1 below. A narrative explanation of each step is after the flow chart.

The general process used in both PolyMet's Antidegradation Evaluation and the MPCA's Antidegradation Review is the same. However, PolyMet's Antidegradation Evaluation relied on FEIS-modeled concentrations from the November 2015 Final Environmental Impact Statement (FEIS) approved by the Minnesota Department of Natural Resources. These FEIS-modeled effluent concentrations provide reliable, protective estimates and are based on ensuring protection of water quality standards. *See* Minn. R. 7050.0280, subp. 3.

PolyMet has also conducted design modeling that projects technologically refined effluent quality based on data collected during bench and pilot testing. This ongoing design modeling confirms that PolyMet can achieve the FEIS-modeled effluent concentrations. As part of its Antidegradation Review, the MPCA chose to also consider the effluent concentrations projected by the design modeling. The design model concentrations are project effluent concentrations based on data, including effluent data, collected during bench and pilot testing and ongoing engineering modeling to scale up the wastewater treatment system design from pilot scale to full-scale. This resulted in more refined projections of future effluent concentrations. Design modeling indicates that concentrations of many of the parameters analyzed may be very close to or below the typical reporting limits; specifically, 12 out of the 21 parameters of concern are projected by the design modeling to be below the typical reporting limit (Table 1 below). Further discussion of the FEIS effluent quality and the design model effluent quality is provided below.

To make an Antidegradation Determination, MPCA considered both the FEIS concentrations provided in PolyMet's Evaluation and the design model concentrations. The FEIS concentrations represent the upper limits of potential effluent quality and the design model concentrations represent an achievable estimate of effluent quality.

The definition of key terms used in the flow chart is below:

Central Tendency: The middle or typical value of a data set. The surface water quality dataset used in this analysis contains a substantial fraction of data points below the detection limit. In such cases, statistics other than an arithmetic average must be used to characterize the "central tendency" of the dataset. An explanation of the methodologies used to calculate the central tendency can be found in Attachment B – Statistical Supplement.

Degradation: "Degradation" or "degrade" means a measurable change to existing water quality made or induced by human activity resulting in diminished chemical, physical, biological, or radiological qualities of surface waters.

Design Model Concentrations: Projected effluent concentrations based on data, including effluent data, collected during bench and pilot testing, and ongoing engineering modeling to scale up the wastewater treatment system design from pilot scale to full-scale. This resulted in more refined projections of future effluent concentrations.

Effluent Concentrations: Projected effluent concentrations from the project, which can refer to the FEIS concentrations and/or the design model concentrations.

Detectable in Effluent: The MPCA defined a value as detectable or not detectable in reference to the typical reporting limits provided in Attachment B, Large Table 1 of the Antidegradation Evaluation. If the projected effluent concentration was greater than the typical reporting limit, then that projected effluent concentration was defined to be detectable. The typical reporting limits provided by PolyMet are consistent with values typically used by the MPCA.

Feasible Alternative: A pollution control alternative that is consistent with sound engineering and environmental practices, is affordable, meets legal requirements, and has supportive governance that can be successfully put into practice to accomplish the task.

FEIS Concentrations: Projected effluent concentrations from the November 2015 Final Environmental Impact Statement (FEIS) approved by the Minnesota Department of Natural Resources.

Measurable Increase: If the projected eflfuent concentration is higher than the 95% UCL of the central tendency, then the effluent concentration will cause a measurable increase in surface water concentration. This definition is the methodology MPCA used to define measurable increase. PolyMet used a different method to define measurable increase.

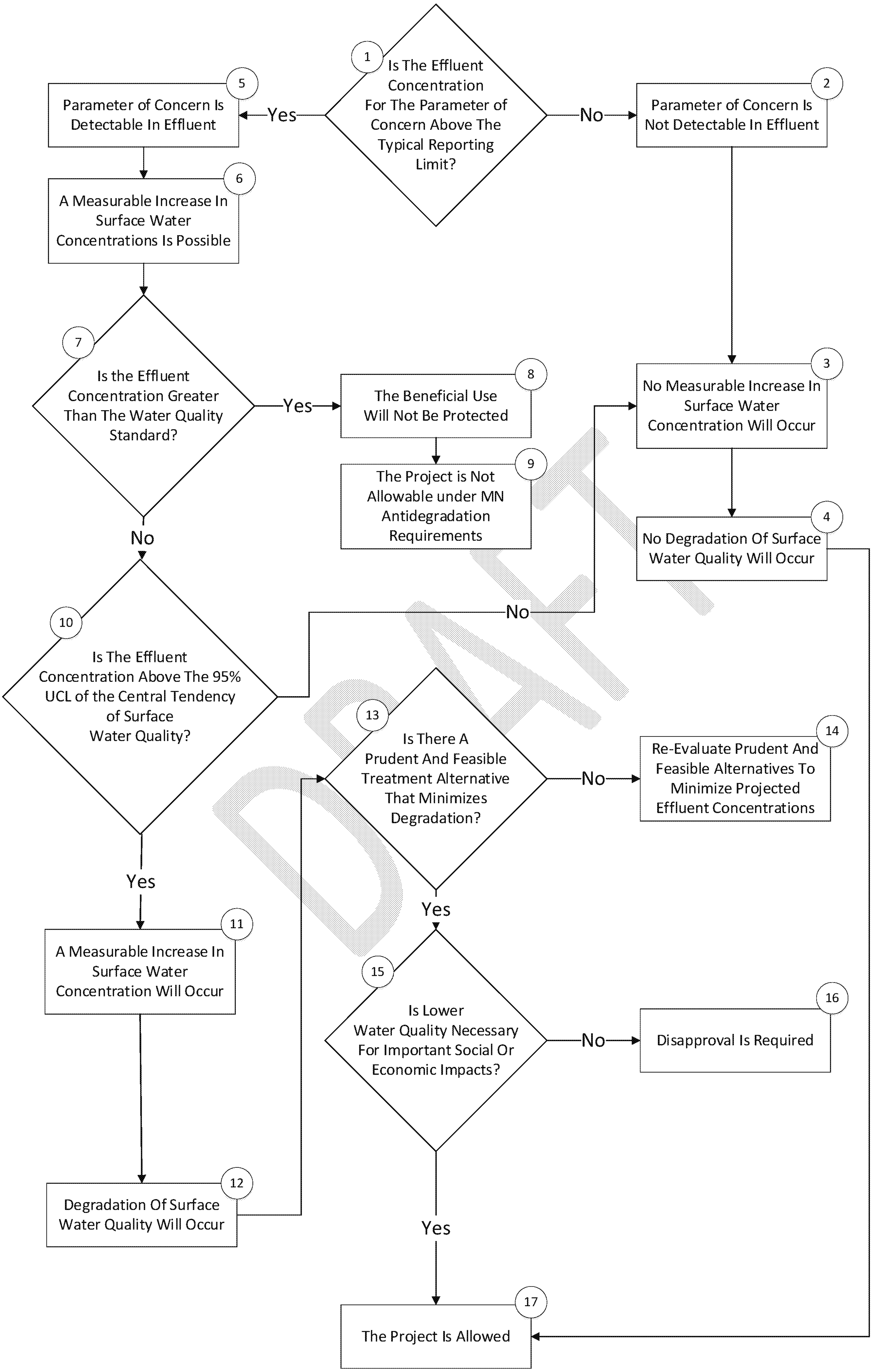
Non-parametric Statistics: A statistical method wherein the data is not required to fit a defined probability distribution.

Prudent Alternative: A pollution control alternative selected with care and sound judgment.

Upper Confidence Limit or UCL: The upper boundary of the 95% confidence interval surrounding the central tendency for the parameter of concern. An explanation of the methodologies used to calculate the UCL can be found in Attachment B – Statistical Supplement.

Typical Reporting Limit: The lowest concentration that a laboratory can accurately measure. PolyMet provided values for each parameter in the Antidegradation Evaluation. MPCA reviewed and confirmed these values were reasonable as typical reporting limits. The typical reporting limits are in Attachment B, Large Table 1 of the Antidegradation Evaluation.

Flowchart 1. Antidegradation Procedures Process



1. Is the projected effluent concentration for the parameter of concern above the typical reporting limit?

All projected surface discharge locations for the project have no surface water assimilative capacity and thus no flow dilution is allowed when considering protection of water quality standards. Because of this lack of dilution, the MPCA made the assumption that the projected effluent concentrations for all parameters of concern will define and ultimately become the surface water quality once the project has initiated discharge.

PolyMet's Antidegradation Evaluation relied on FEIS-modeled concentrations and MPCA also considered the design model effluent concentrations in its antidegradation review. *See* Minn. R. 7050.0280 subp. 3. The MPCA chose to include an evaluation of the design model concentrations because they are more refined than the FEIS concentrations. Many of the concentrations analyzed in this antidegradation review are very close to or below the typical reporting limit. For example, using the design model projected effluent concentrations, 12 out of the 21 parameters of concern are projected to be below the typical reporting limit (Table 2 below). Further explanation of the design model concentrations and the FEIS-modeled concentrations is below.

The MPCA determined that it is not statistically appropriate to evaluate values projected to be below the typical reporting limit using the same logic as values projected to be above the typical reporting limit.

2. The parameter of concern is not detectable

The MPCA defined a value as detectable or not detectable in reference to the typical reporting limits. These values can also be found summarized in Table 2 of this document below.

If the projected effluent concentration was less than the typical reporting limit, then that projected effluent concentration was defined to be not detectable.

3. No measurable increase in surface water concentration will occur

If the projected effluent concentration is expected to be not detectable, then no measurable increase in surface water quality concentrations will occur.

If the projected effluent concentration is expected to be not detectable, then there will also be no measurable increase in mass loading of the parameter of concern.

4. No degradation of surface water quality will occur

If there will be no measurable increase in surface water quality concentrations or mass loading, then by the definition of "degradation," there can be no degradation of existing water quality for the parameter of concern.

5. The parameter of concern is detectable

If the projected effluent concentration was greater than the typical reporting limit, then that projected effluent concentration was defined to be detectable.

6. A measurable increase in surface water concentration is possible

If the parameter of concern is detectable in the effluent using design model concentrations, there is a possibility that a measurable change in surface water concentrations could occur.

7. Is the concentration greater than the water quality standard?

The MPCA defined the reference water quality standards as those in Minnesota Rule 7050 and 7052 as summarized below in Table 2 below and in Table 3-2 of the Antidegradation Evaluation.

8. The beneficial use will not be protected

If the projected effluent concentration is above the water quality standard for any parameter, then the beneficial use would not be protected.

9. The project is not approvable under Minnesota antidegradation requirements

Minn. R. 7050.0265, subp. 4, does not allow for approval of a proposed activity that would permanently preclude attainment of water quality standards. In addition, the commissioner has authority to approve a proposed activity only when existing uses and the level of water quality necessary to protect existing uses are maintained and protected. Minn. R. 7050.0265 subp. 2.

10. Comparing effluent concentrations to surface water quality

This analysis allows for comparison of whether the projected effluent concentration will be outside the estimated central tendency of existing water quality. The basis and rationale for this comparison is described beginning on page 14.

11. A measurable increase in surface water concentration will occur

If the projected design model concentration is higher than the 95% UCL of the central tendency in the receiving water of concern, then the effluent concentration will cause a measured increase in surface water concentration. The rationale for the method used to assess whether a measurable increase occurred is described later in this document.

12. Degradation of surface water quality will occur

If a measurable increase in surface water concentration will occur because of the project, then there will be degradation in surface water quality.

13. Is there a prudent and feasible treatment alternative that minimizes degradation?

A more detailed description of the methodologies used to evaluate prudent and feasible alternatives that minimize degradation is provided on page 14 of this document.

14. Re-evaluate prudent and feasible alternatives to minimize projected effluent concentrations

If the project does not incorporate a prudent and feasible alternative that minimizes degradation, then the proposed alternatives need to be re-evaluated in order to minimize projected effluent concentrations associated with the project.

15. Is lower WQ necessary for important social or economic changes?

Degradation can only be allowed to accommodate important economic or social changes. A description of the methodologies used to evaluate whether the amount of degradation by this project is necessary to accommodate important economic or social changes is found on page 16 of this document.

16. Disapproval is required

If the amount of degradation is not necessary to accommodate important economic or social changes, then the project cannot be approved by the commissioner.

17. The Project is Allowed

The project fulfills Minnesota antidegradation requirements and is allowed.

This box represents the process the MPCA makes to determine whether the lower water quality resulting from the proposed activity is necessary to accommodate important economic or social changes in the geographic area in which degradation of existing high water quality is anticipated.

18. The project satisfies antidegradation requirements

The project is allowable only if compliance with all antidegradation statutes has been demonstrated.

Antidegradation Review Rationale

Antidegradation standards apply

Minn. R. 7050.0265, Subp. 1 – Scope.

This part applies to activities regulated by the following control documents:

A. new, reissued, or modified individual NPDES wastewater permits…

PolyMet has applied for a new NPDES/SDS individual wastewater permit. Thus, the antidegradation standards of Minn. R. 7050.0265 apply.

There will be no physical alteration to surface waters and thus compensatory mitigation is not proposed as a means to preserve an existing use

Minn. R. 7050.0265, Subp. 3 – Compensatory mitigation.

A. The commissioner shall allow compensatory mitigation as a means to preserve an existing use when there is a physical alteration to a surface water only when all of the following conditions are met….

This scope of this review is limited to the NPDES-permitted discharges from the WWTS proposed by PolyMet. The proposed activity addressed in this review will not result in a physical alteration to a surface water and thus, compensatory mitigation as a means to preserve an existing use is not allowed or considered. Issues related to physical alterations of surface waters and compensatory mitigation are addressed in the Section 401 certification antidegradation review.

Existing uses will be maintained and protected and attainment of water quality standards would not be precluded

Minn. R. 7050.0265, Subp. 2 – Protection of existing uses.

The commissioner shall approve a proposed activity only when existing uses and the level of water quality necessary to protect existing uses are maintained and protected

Minn. R. 7050.0265, Subp. 4 - Protection of beneficial uses.

The commissioner shall not approve a proposed activity that would permanently preclude attainment of water quality standards.

Minnesota rules require protection of existing uses and maintenance of the level of water quality necessary to protect those uses (Minn. R. 7050.0265 subp. 2; Minn. R. 7052.0300 subp. 2). To evaluate whether the WWTS discharge will degrade water quality or remove an existing use, MPCA considered the reliable information available, determined the methods of analyzing the data, determined existing water quality, analyzed projected effluent discharges, and determined whether degradation would occur to a degree that would preclude attainment of standards.

Reliable information considered

The MPCA may use the antidegradation evaluation completed by PolyMet or any other reliable information in conducting its antidegradation review. *See* Minn. R. 7050.0280 subp. 3. The MPCA considered the data provided in the Antidegradation Evaluation as well as the supporting documentation.

PolyMet conducted its Antidegradation Evaluation using a set of projected effluent concentrations (Section 3.1.1, Table 3-2, pp. 18-22 of the Antidegradation Evaluation). Figure 1 and Table 1 below show the differences between what are referred to as the FEIS concentrations, which are largely the FEIS concentrations but also include alternate protective values for several parameters as provided in the Antidgradation Evaluation, and the design model concentrations.

Figure 1. Comparison of FEIS and Design Model Effluent Concentrations for Mine Year 10. A "ND" label indicates that the value is less than the typical reporting limit. The sulfate ratio was calculated using the 10 mg/L internal Operating Limit in the draft permit. The design model TDS and specific conductance values were calculated using the same methods in Attachment A of the Antidegradation Evaluation.

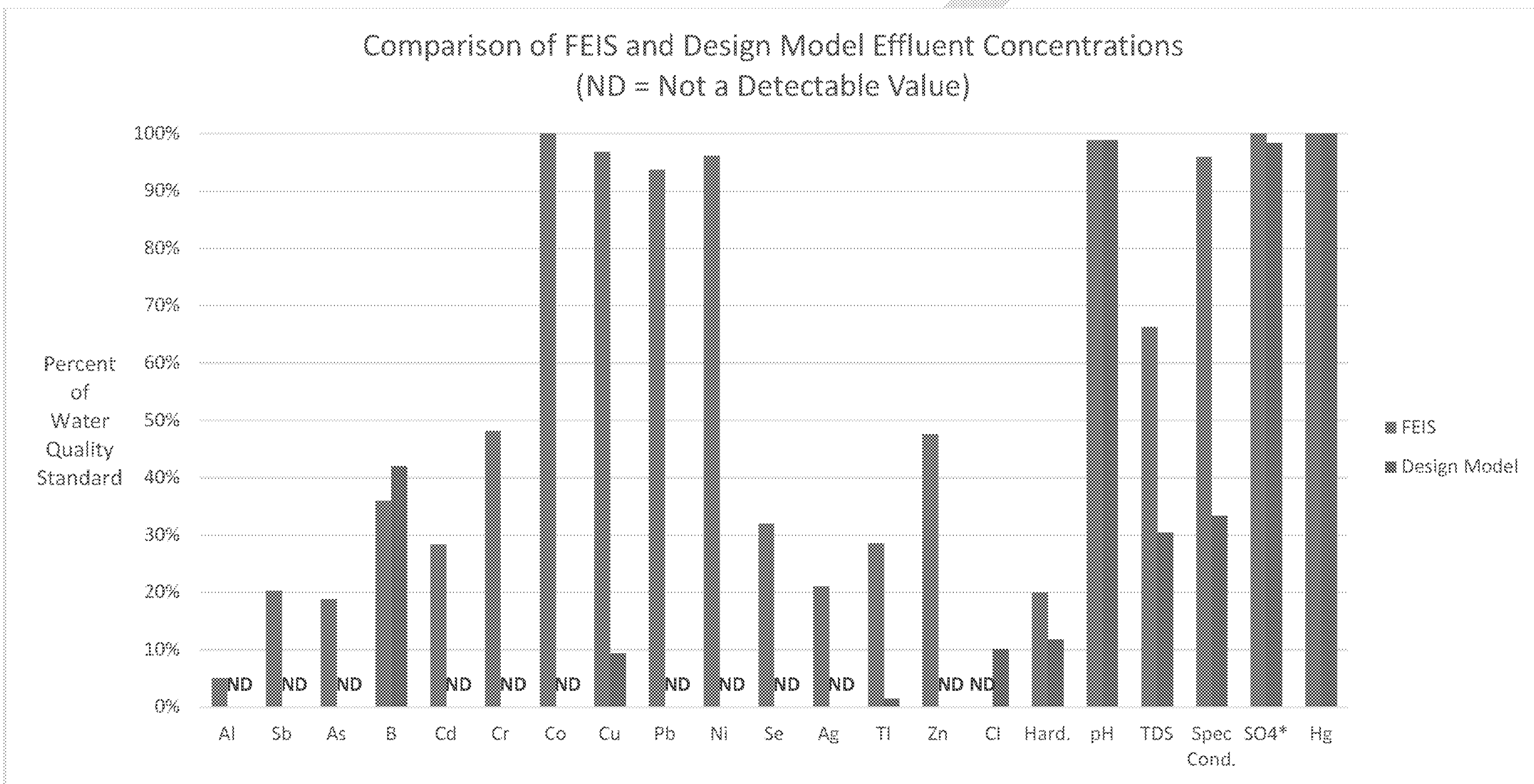


Table 2. Tabular comparison of FEIS concentrations and Design Model concentration in relation to typical reporting limits and the applicable water quality standard.

Parameter	Units	Applicable WQS	Typical Reporting Limit	FEIS Effluent Quality[1]	Design Model Effluent Quality	FEIS Detectable?	Design Model Detectable?
Aluminum (total)	µg/L	125	2	6.3	0.43	Detectable	Not Detectable
Antimony (total)	µg/L	31	0.53	6.3	0.38	Detectable	Not Detectable
Arsenic (total)	µg/L	53	0.5	10	0.004	Detectable	Not Detectable
Boron (total)	µg/L	500	100	230	210	Detectable	Detectable
Cadmium (total)	µg/L	2.5	0.2	0.71	0.056	Detectable	Not Detectable
Chromium (total)	µg/L	11	1	5.3	0.31	Detectable	Not Detectable
Cobalt (total)	µg/L	5	0.2	5	0.011	Detectable	Not Detectable
Copper (total)	µg/L	9.3	0.5	9	0.87	Detectable	Detectable
Lead (total)	µg/L	3.2	0.5	3	0.099	Detectable	Not Detectable
Nickel (total)	µg/L	52	0.5	50	0.14	Detectable	Not Detectable
Selenium (total)	µg/L	5	1	1.6	0.046	Detectable	Not Detectable
Silver (total)	µg/L	1	0.2	0.21	0.059	Detectable	Not Detectable
Thallium (total)	µg/L	0.56	0.005	0.16	0.008	Detectable	Detectable
Zinc (total)	µg/L	120	6	57.1	0.065	Detectable	Not Detectable
Chloride	mg/L	230	5	23.4	23.4	Detectable	Detectable
Hardness (as $CaCO_3$)	mg/L	500	10	100	59.1	Detectable	Detectable
pH	SU	8.5	0.01	8.4	8.4	Detectable	Detectable
TDS	mg/L	700	10	464	213	Detectable	Detectable
Specific Conductance	µS/cm	1,000	0	960	334	Detectable	Detectable
Mercury (total)	ng/L	1.3	0.5	1.3	≤ 1.3[2]	Detectable	Not Detectable
Sulfate*	mg/L	10*	1	≤ 10	9.84	Detectable	Detectable

(1) The concentrations listed here are those used by PolyMet in its Antidegradation Evaluation. They are the FEIS concentrations, with the exceptions of boron, chloride, pH, sulfate and mercury as discussed above. Values for those parameters were revised as a protective assumption for the Evaluation. Additionally, TDS and specific conductance were calculated from the ionic strength using correlations from Snoeyink and Jenkins (1980). See PolyMet's Antidegradation Evaluation Table 3-2.

(2) Mercury concentrations were assumed to be less than or equal to the 1.3 ng/L water quality standard.

*The 10 mg/L sulfate standard is not applicable in the immediate receiving waters; this is an internal Operating Limit in the draft permit.

The distinction between FEIS concentrations and design model concentrations is important in understanding how designated uses and water quality criteria will be protected with the projected discharge.

> **FEIS concentrations** means the projected effluent quality from GoldSim modeling used in the FEIS effects analysis. Conservative/protective assumptions were made in GoldSim modeling regarding the WWTS effluent for the purposes of assessing downstream project impacts in the FEIS. The assumptions were conservative/protective since confidence was high that actual effluent quality would be equal to or better than these assumptions (based on pilot testing and design modeling). The FEIS concentrations are less than or equal to the values reported on EPA Form 2D of the permit application. For its Antidegradation Evaluation, PolyMet made additional conservative/protective assumptions for three parameters (boron, sulfate and chloride), and added protective/conservative values for two other parameters (mercury and pH) that were not included in the FEIS GoldSim modeling. For simplicity, this report includes all five of these parameters within the term FEIS concentrations with footnotes when appropriate (i.e., in tables and figures).
>
> **Design model concentrations** means the projected effluent quality developed by PolyMet based on data, including effluent data, collected during bench and pilot testing. Advanced engineering design modeling was performed using this data to provide detailed engineering information necessary to scale up the wastewater treatment system design from pilot scale to full-scale. Design model concentrations used in this report are for Mine Year 10, which is the year that is expected to have the highest loading to the WWTS. This resulted in refined projections representative of an achievable potential effluent quality. During operations, the actual WWTS effluent quality could vary from the design model results for a number of reasons, including the actual membrane rejection rates over time, compared to the average values used in the design model, and the blend of reverse osmosis and nanofiltration used to achieve the sulfate internal performance target.

The new information obtained for the design model concentrations through more recent advanced engineering design of the treatment system demonstrates that every parameter except for boron, chloride, and sulfate will be treated to equivalent or lower levels than assumed in the FEIS effects analysis. This conclusion is supported by the results of the "Plant Site Wastewater Treatment Plant Pilot Testing" report <Link> and the "Wastewater Treatment System Design and Operation Report"<Link> submitted as a reference to the NPDES/SDS permit application.

The MPCA considered both the FEIS concentrations and the design model concentrations in completing the Antidegradation Review. Figure 1 provides a visual representation of the difference between the FEIS concentrations and the design model concentrations for selected parameters of concern in relation to water quality standards while also considering typical reporting limits.

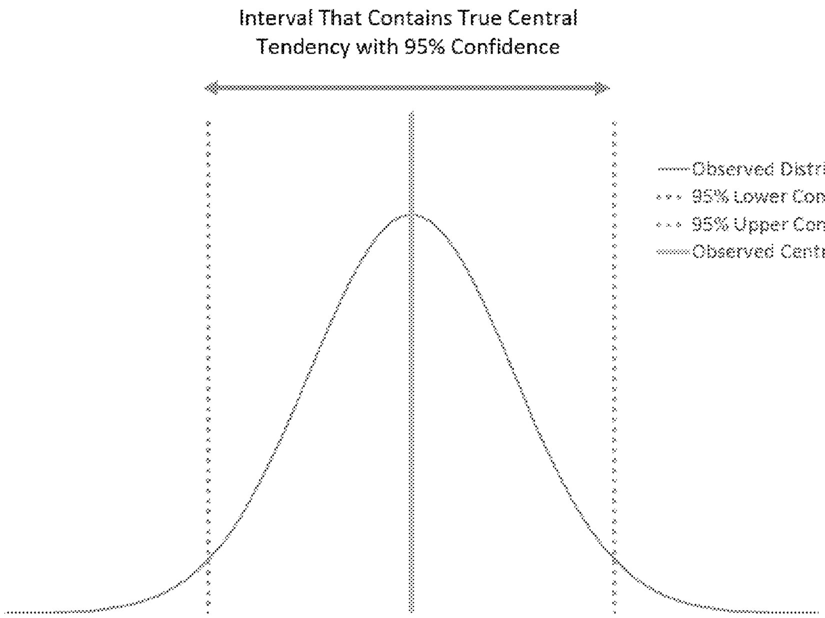
Data analysis methodology

After determining the projected effluent quality, the MPCA reviewed whether effluent of such quality would result in a measurable changed in water quality.

Existing water quality was determined using the methods in Minnesota Rule 7050.0260 (as described in Sections 6.2 (pp. 49-54) and 8.2 (pp. 84-85) of PolyMet's Antidegradation Evaluation) and the potential for a measurable change in water quality was assessed in Sections 6.3 (pp. 54-65) and 8.3 (pp. 85-93) of the Evaluation. Existing water quality was calculated using monitoring data that are sufficient to reflect the conditions of the surface waters. As described below, MPCA characterized existing water quality using the central tendency, more specifically the 95% UCL of that central tendency – the highest value that the central tendency probably remains below with 95% confidence.

The MPCA chose to compare the design model concentrations to the central tendency of the surface water quality because the central tendency is a good indicator of typical water quality. Assessing water quality changes against the central tendency allows a determination of whether there would be any measurable changes in typical water quality. The true central tendency of surface water quality should not be thought of as a single value, but rather as an interval with an upper bound of an upper confidence limit (UCL) and a lower bound of the lower confidence limit (Figure 2). This is because a complete, continuous data set of measured water quality concentrations is not available for any parameter at any location evaluated. An exact singular value representing the true central tendency of the surface water quality can only be calculated when the data set contains an infinite number of data points. While it is impossible to collect an infinite amount of data points, PolyMet did collect an appropriate number of data points (11-296) for each parameter at each location to characterize existing water quality. PolyMet then used this data set to appropriately calculate a value (see Attachment A) that is 95% likely to contain the true central tendency. The MPCA did not consider the lower 95% confidence interval of the true central tendency, because this review is most concerned with the upper range of water quality values that are closer to the water quality standard and the lower 95% UCL is likely to be below the detection limit for most parameters.

Figure 2. Graphical representation of how confidence intervals are used to characterize the true mean with 95% confidence. This figure assumes the observed distribution of data is normally and continuously distributed.



The design model effluent concentrations do not have conventional uncertainty intervals (i.e., X µg/L ± Y%) because the wastewater design model does not have the capacity to estimate such uncertainty intervals. Therefore, the MPCA treated the projected design model effluent concentrations as a realistic estimate of the achievable future effluent concentrations. In contrast, surface water quality at each location was characterized by a range of data points and not by a single data point or value.

When choosing a statistical methodology to compare these two data types (i.e., a single value versus a range of data), conventional statistical tests such as a two-sample t-test are not appropriate and indicators of statistical significance such as P-values cannot be generated. Consequently, the MPCA decided to assess measurable change using the simple analysis of determining whether the design model concentration for any parameter was higher or lower than the 95% UCL of surface water quality.

PolyMet initially chose to calculate average existing water quality using substitution methodologies in its Antidegradation Evaluation; it later submitted, at MPCA's request, a statistical supplement attached to this document (Attachments A & B) with different statistical methodologies. In PolyMet's approach in the Antidegradation Evaluation, if the data set had a measured value less than the detection limit, a value of ½ the detection limit was assigned. Calculating averages using substitution methodologies is not recommended by the creators of the EPA statistical software package used in this analysis (ProUCL Version 5.1 Technical Guide, EPA). The MPCA therefore requested that PolyMet recalculate surface water quality statistics ; PolyMet completed the calculations and submitted that information to the MPCA (Table 2 below; Attachment B of Antidegradation Evaluation). The summarized statistics are attached to this document and were used by the MPCA to define existing water quality; these tables contain different values than the summary statistics in Large Table 2 of Volume V of the NPDES/SDS permit application because of the use of more appropriate statistical methodologies.

In its Antidegradation Evaluation, PolyMet assessed measurable change by characterizing the variability surrounding the average surface water concentration using the variability of the Laboratory Control Samples (LCS) acceptance criteria, not the actual measured water quality variability. The PolyMet approach to determining existing water quality does not consider the measured variability surrounding the average concentrations as shown in Figure 3 below. Therefore, in its review the MPCA chose to use the UCL, as discussed above.

Figure 3 uses total nickel values at SD026/PM-7 to contrast the PolyMet and the MPCA approach to determining existing water quality. In Figure 3, the PolyMet approach uses ½ the detection limit substitution methods to calculate the average nickel value and assumes the variability surrounding that average is +/- 0.2 µg/L, which is the typical LCS range for nickel at that concentration value. The MPCA considered the range of measured values, including the 95% UCL. For example, MPCA assumes the water quality variability is bounded by the 95% UCL (2.8 µg/L) because the existing water quality must take into account the measured natural variability around the central tendency. This is consistent with the definition of "existing water quality" in the antidegradation rule, Minn. R. 7050.0255, subp. 16. MPCA determined that a measurable change would not occur if the projected effluent concentration was within the measured natural variability as defined by the 95% UCL.

Degradation Review

Considering the FEIS concentrations and the evaluation of existing water quality and measurable change provided in PolyMet's Evaluation, 13 parameters would experience degraded water quality at SD026 because of the proposed discharge (Table 2). Considering the more refined design model concentration and the 95% UCL definition of measurable change predicts only four parameters would experience degraded water quality at SD026 (Table 2) and also predicts a smaller extent of degradation for three of the four (Table 3). Using the design model concentrations does not assume degradation where no degradation is likely to occur and better reflects the future performance of the WWTS. Ultimately, both of these approaches reach the same result, which is that degradation of water quality for some parameters will occur and therefore it is necessary to assess whether the proposed Project will meet criteria for any degradation to occur under Minnesota antidegradation requirements.

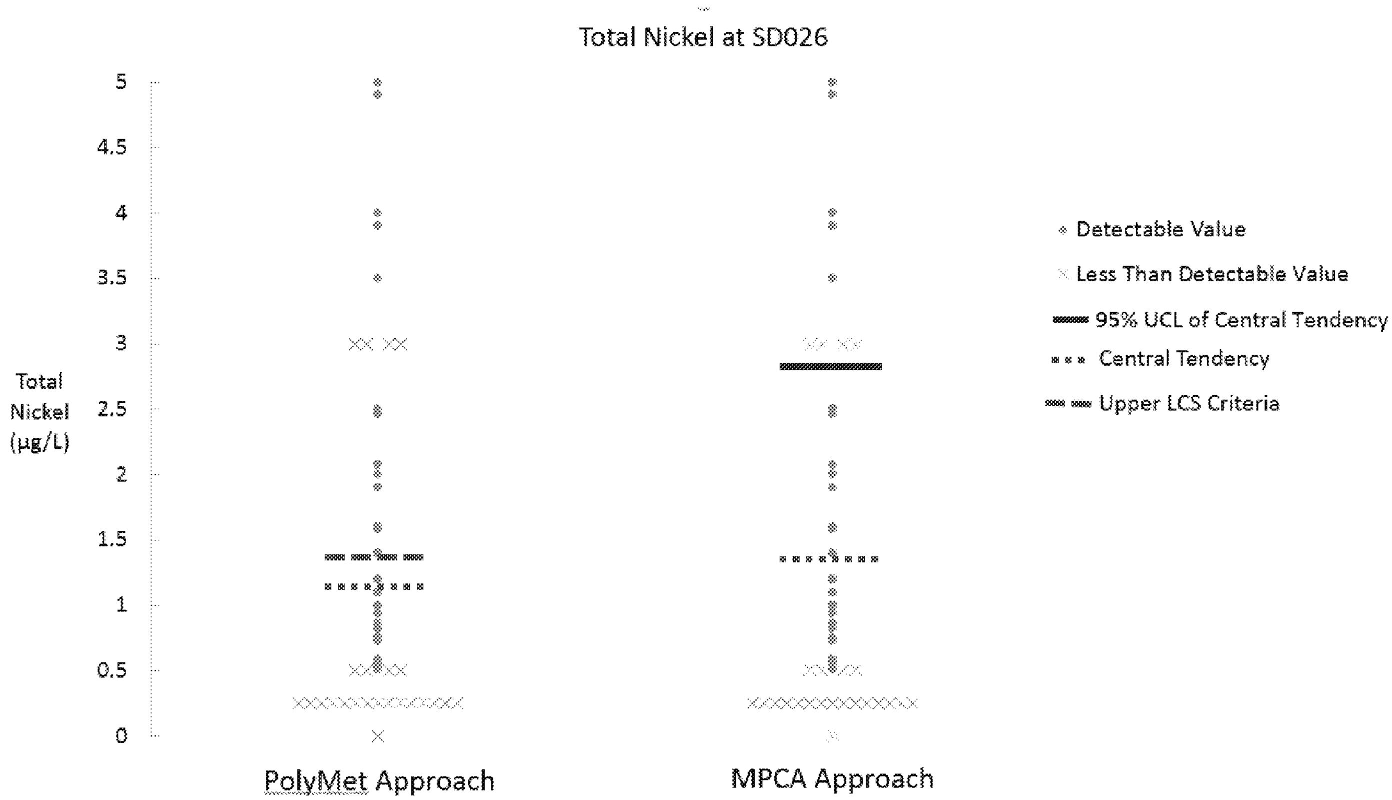
Table 2. Comparison of the results of the MPCA's and PolyMet's approach to assess whether or not the projected discharge will cause degraded water quality. A cell containing "Degradation" indicates degradation will occur and a blank cell indicates no degradation is expected to occur.

	SD026		TC1-a		PM-11	
	Initial Evaluation Approach	Additional Review Approach	Initial Evaluation Approach	Additional Review Approach	Initial Evaluation Approach	Additional Review Approach
Aluminum (total)						
Antimony (total)	Degradation		Degradation		Degradation	
Arsenic (total)	Degradation		Degradation		Degradation	
Boron (total)			Degradation	Degradation		
Cadmium (total)	Degradation		Degradation		Degradation	
Chromium (total)	Degradation		Degradation		Degradation	
Cobalt (total)	Degradation		Degradation		Degradation	
Copper (total)	Degradation		Degradation	Degradation	Degradation	
Lead (total)	Degradation		Degradation		Degradation	
Nickel (total)	Degradation		Degradation		Degradation	
Selenium (total)	Degradation		Degradation		Degradation	
Silver (total)			Degradation		Degradation	
Thallium (total)		Degradation	Degradation	Degradation	Degradation	
Zinc (total)	Degradation		Degradation		Degradation	
Chloride	Degradation	Degradation	Degradation	Degradation	Degradation	Degradation
Hardness (as $CaCO_3$)						
pH	Degradation	Degradation	Degradation	Degradation	Degradation	Degradation
TDS						
Specific Conductance			Measurable Increase*		Measurable Increase*	
Sulfate						
Mercury (total)	Degradation	Degradation				

1. Degradation (measurable increase) evaluated using LCS acceptance criteria and FEIS effluent concentrations.
2. Degradation (measurable increase) evaluated using 95% UCL and design model effluent concentrations.

*Tier 2 protection of high water quality does not apply to class 4A water quality standards and the antidegradation review only evaluates Tier 1 protection of beneficial and existing uses. This distinction is noted by using the words "Measurable Increase" instead of "Degradation."

Figure 3. Comparison of the PolyMet approach for determining measurable change to the MPCA approach for determining measurable change. The PolyMet approach uses the upper LCS acceptance criteria and the MPCA approach has 95% upper confidence limits associated with the range of sixty measured surface water quality data points. Less than detectable values are shown jittered at their respective measured detection limits.



The MPCA analyzed the measurable change in water quality only with respect to concentrations and did not evaluate measurable change with respect to mass rate loadings. This decision was based on the slight net decrease in water flow rate from the site expected with the project. The NPDES application projected net changes in flow to the Embarrass River and Lower Partridge River of less than two percent. *See* Antidegradation Evaluation, Attachment F, Tables 1 and 2. Because the water flow rate will decrease and mass loading is the product of water flow and water concentration, the only factor that could increase mass loading in this case is changes in concentration. Consequently, change in concentration is a direct surrogate for changes in mass loading and assessing for changes in concentration is also protective for changes in mass loading.

Projected effluent evaluation

Using the data described above, MPCA compared the projected discharge to the 95% UCL for each parameter at each receiving water as well as the central tendency and the maximum value. Tables 3, 4, and 5 below show the results of this evaluation for SD026/PM-7, TC-1a and PM-11 respectively. The MPCA found that according to the design model effluent quality and the FEIS concentrations, all water quality standards would be met. In addition, the design model concentrations are below the applicable downstream drinking water standards.[1] The method of analysis for the MPCA's comparison of the projected discharge to the 95% UCL for each parameter at each receiving water follows the tables.

[1] Lake Superior is downstream of all discharge points and is designated a Class 1B drinking water.

Table 3. Values used to assess whether the proposed discharge would cause a measurable increase in surface water concentrations at SD026/PM-7.

			Effluent		Surface Water (SD026/PM-7)					Measurable Increase Analysis			
Parameter	Units	Typical Reporting Limit	Design Model Effluent Quality	Design Model Effluent Quality Detectable?	Sample Count	Detectable Value Count	Likely Central Tendency	95% UCL of Central Tendency	Max Value	Measurable Increase Possible?	Measurable increase in reference to central tendency?	Measurable increase in reference to 95% UCL?	Measurable increase in reference to max value?
Aluminum (total)	µg/L	2	0.43	Not Detectable	55	25	23.3	63.7	63.7	No	---	---	---
Antimony (total)	µg/L	0.53	0.38	Not Detectable	11	0	< 0.5	< 0.5	< 0.5	No	---	---	---
Arsenic (total)	µg/L	0.5	0.004	Not Detectable	41	19	0.51	0.7	2	No	---	---	---
Boron (total)	µg/L	100	210	Detectable	98	96	211	221	311	Yes	No	No	No
Cadmium (total)	µg/L	0.2	0.056	Not Detectable	27	2	< 0.2	< 0.2	0.097	No	---	---	---
Chromium (total)	µg/L	1	0.31	Not Detectable	20	3	< 1	1.7	1.7	No	---	---	---
Cobalt (total)	µg/L	0.2	0.011	Not Detectable	102	49	0.48	1	1	No	---	---	---
Copper (total)	µg/L	0.5	0.87	Detectable	68	50	0.96	1.04	2.02	Yes	No	No	No
Lead (total)	µg/L	0.5	0.099	Not Detectable	54	2	< 0.5	1	1	No	---	---	---
Nickel (total)	µg/L	0.5	0.14	Not Detectable	60	36	1.11	2.81	5	No	---	---	---
Selenium (total)	µg/L	1	0.046	Not Detectable	31	3	< 1	2	2	No	---	---	---
Silver (total)	µg/L	0.2	0.059	Not Detectable	17	1	< 0.24	1	1	No	---	---	---
Thallium (total)	µg/L	0.005	0.008	Detectable	21	2	< 0.005	< 0.2	0.003	Yes	Yes	Yes	Yes
Zinc (total)	µg/L	6	0.065	Not Detectable	68	25	7.5	16.8	82.5	No	No	No	No
Chloride	mg/L	5	23.4	Detectable	155	155	11.5	12	21.5	Yes	Yes	Yes	Yes
Hardness (as $CaCO_3$)	mg/L	10	59.1	Detectable	220	220	466	479	780	Yes	No	No	No
pH	SU	0.01	8.4	Detectable	296	296	7.8	7.9	8.7	Yes	Yes	Yes	No
TDS	mg/L	10	213	Detectable	155	155	650	669	1540	Yes	No	No	No
Spec	µS/cm	0	334	Detectable	299	299	1005	1024	1393	Yes	No	No	No
Sulfate	mg/L	1	9.84	Detectable	154	153	173	179	360	Yes	No	No	No
Mercury (total)	ng/L	0.5	≤ 1.3*	Detectable	89	47	0.6	0.7	2.1	Yes	Yes**	Yes**	No**

*Mercury concentrations were assumed to be less than or equal to the 1.3 ng/L water quality standard.

**Measurable increase was calculated by assuming that the design model effluent quality was equal to the highest possible effluent concentration of 1.3 ng/L and not the censored value of ≤ 1.3 ng/L.

Table 4. Values used to assess whether the proposed discharge would cause a measurable increase in surface water concentrations at TC-1a.

			Effluent		Surface Water (TC-1a)					Measurable Increase Analysis			
Parameter	Units	Typical Reporting Limit	Design Model Effluent Quality	Effluent Detectable?	Sample Count	Detectable Value Count	Likely Central Tendency	95% UCL of Central Tendency	Max Value	Measurable Increase Possible?	Measurable increase in reference to central tendency?	Measurable increase in reference to 95% UCL?	Measurable increase in reference to max value?
Aluminum (total)	µg/L	2	0.43	Not Detectable	38	28	23.6	26.9	76.4	No	---	---	---
Antimony (total)	µg/L	0.53	0.38	Not Detectable	17	0	< 0.5	< 0.5	< 0.5	No	---	---	---
Arsenic (total)	µg/L	0.5	0.004	Not Detectable	38	20	0.9	1.23	3.7	No	---	---	---
Boron (total)	µg/L	100	210	Detectable	12	11	142	155	185	Yes	Yes	Yes	Yes
Cadmium (total)	µg/L	0.2	0.056	Not Detectable	12	0	< 0.2	< 0.2	< 0.2	No	---	---	---
Chromium (total)	µg/L	1	0.31	Not Detectable	12	0	< 1	< 1	1	No	---	---	---
Cobalt (total)	µg/L	0.2	0.011	Not Detectable	38	18	< 0.2	0.3	0.72	No	---	---	---
Copper (total)	µg/L	0.5	0.87	Detectable	38	17	< 0.5	0.8	3.6	Yes	Yes	Yes	No
Lead (total)	µg/L	0.5	0.099	Not Detectable	38	0	< 0.5	< 0.5	< 0.5	No	---	---	---
Nickel (total)	µg/L	0.5	0.14	Not Detectable	38	10	< 0.5	0.6	1.2	No	---	---	---
Selenium (total)	µg/L	1	0.046	Not Detectable	24	0	< 1	< 1	< 1	No	---	---	---
Silver (total)	µg/L	0.2	0.059	Not Detectable	5	0	< 0.2	< 0.2	< 0.2	No	---	---	---
Thallium (total)	µg/L	0.005	0.008	Detectable	24	0	< 0.005	< 0.02	< 0.02	Yes	Yes	Yes	Yes
Zinc (total)	µg/L	6	0.065	Not Detectable	38	2	< 6	11.5	11.5	No	---	---	---
Chloride	mg/L	5	23.4	Detectable	38	38	17.3	19.5	33.5	Yes	Yes	Yes	No
Hardness (as $CaCO_3$)	mg/L	10	59.1	Detectable	38	38	331	366	547	Yes	No	No	No
pH	SU	0.01	8.4	Detectable	38	38	7.4	7.44	7.82	Yes	Yes	Yes	Yes
TDS	mg/L	10	213	Detectable	38	38	474	511	722	Yes	No	No	No
Spec	µS/cm	0	334	Detectable	38	38	723	795	1150	Yes	No	No	No
Sulfate	mg/L	1	9.84	Detectable	38	36	51	62.19	132	Yes	No	No	No
Mercury (total)	ng/L	0.5	≤ 1.3*	Detectable	12	12	2.13	2.81	5.1	Yes	No	No	No

*Mercury concentrations were assumed to be less than or equal to the 1.3 ng/L water quality standard.

Table 5. Values used to assess whether the proposed discharge would cause a measurable increase in surface water concentrations at PM-11.

			WWTP Effluent		Surface Water (PM-11)					Measurable Increase Analysis			
Parameter	Units	Typical Reporting Limit	Design Model Effluent Quality	Effluent Detectable?	Sample Count	Detectable Value Count	Likely Central Tendency	95% UCL	Max Value	Measurable Increase Possible?	Measurable increase in reference to central tendency?	Measurable increase in reference to 95% UCL?	Measurable increase in reference to max value?
Aluminum (total)	µg/L	2	0.43	Not Detectable	66	48	29.9	34	119	No	---	---	---
Antimony (total)	µg/L	0.53	0.38	Not Detectable	35	0	< 0.5	< 3	< 3	No	---	---	---
Arsenic (total)	µg/L	0.5	0.004	Not Detectable	58	35	0.92	1	4.1	No	---	---	---
Boron (total)	µg/L	100	210	Detectable	23	22	210	232	307	Yes	No	No	No
Cadmium (total)	µg/L	0.2	0.056	Not Detectable	26	5	< 0.2	< 0.2	0.069	No	---	---	---
Chromium (total)	µg/L	1	0.31	Not Detectable	26	5	< 1	2.3	2.3	No	---	---	---
Cobalt (total)	µg/L	0.2	0.011	Not Detectable	64	17	< 0.2	0.8	7.6	No	---	---	---
Copper (total)	µg/L	0.5	0.87	Detectable	66	53	0.84	0.9	2.3	Yes	Yes	No	No
Lead (total)	µg/L	0.5	0.099	Not Detectable	60	6	< 0.5	< 1	0.15	No	---	---	---
Nickel (total)	µg/L	0.5	0.14	Not Detectable	66	25	0.57	0.7	1.7	No	---	---	---
Selenium (total)	µg/L	1	0.046	Not Detectable	42	3	< 1	< 3.6	0.61	No	---	---	---
Silver (total)	µg/L	0.2	0.059	Not Detectable	21	0	< 0.2	< 1	< 1	No	---	---	---
Thallium (total)	µg/L	0.005	0.008	Detectable	47	5	0.0075	0.0092	0.0092	Yes	Yes	No	No
Zinc (total)	µg/L	6	0.065	Not Detectable	66	7	< 6	41.2	41.2	No	---	---	---
Chloride	mg/L	5	23.4	Detectable	81	81	17	18.6	34.1	Yes	Yes	Yes	No
Hardness (as $CaCO_3$)	mg/L	10	59.1	Detectable	66	66	373	407	705	Yes	No	No	No
pH	SU	0.01	8.4	Detectable	76	76	7.6	7.6	8.3	Yes	Yes	Yes	Yes
TDS	mg/L	10	213	Detectable	66	66	492	532.4	927	Yes	No	No	No
Specific Conductance	µS/cm	0	334	Detectable	70	70	793	848.6	1386	Yes	No	No	No
Sulfate	mg/L	1	9.84	Detectable	85	85	115	145.7	245	Yes	No	No	No
Mercury (total)	ng/L	0.5	≤ 1.3*	Detectable	12	32	1.73	2.1	5.95	Yes	No	No	No

*Mercury concentrations were assumed to be less than or equal to the 1.3 ng/L water quality standard.

Analysis findings

MPCA reviewed the comparison of the projected discharges against the water quality standards above. In all cases, water quality standards would be met in the receiving waters. For all parameters except those below in Table 6, the MPCA projects no degradation from the new discharge (Table 2). MPCA identified the parameters and discharge points expected to be above the 95% UCL of central tendency of measured surface water values. In the cases of pH, mercury, copper, thallium, boron and chloride, where a small measurable increase in water quality would occur, the degradation was minimized. Degradation is allowed only to the extent necessary to accommodate important economic or social changes as described in the following section and in Antidegradation Evaluation Sections 7.4 (pp. 70-77) and 9.3 (pp. 96-99). Tables 6 below provides a summary of the parameters that will experience degraded water quality based on the design model effluent quality.

Table 6. Summary of the expected degradation associated with the project in comparison to the 95% UCL of the central tendency of surface water quality.

Location	Parameter	Degradation Predicted?	Water Quality Standard	95% UCL	Projected Water Quality	Projected Increase	Degradation as a percentage of the Water Quality Standard
PM-11	Chloride	Yes	230	18.6	23.4	4.8 mg/L	1.95%
PM-11	pH	Yes	6 to 9	7.6	8.4	0.8 $\log_{10}$	---
SD026/PM-7	Mercury	Yes	1.3	0.6	≤ 1.3	≤ 0.7 ng/L	≤ 53%
SD026/PM-7	Chloride	Yes	230	12	23.4	11.4 mg/L	4.95%
SD026/PM-7	Thallium	Yes	0.56	< 0.2	0.008	0.008 µg/L	1.42%
SD026/PM-7	pH	Yes	6 to 9	7.9	8.4	0.5 $\log_{10}$	---
TC-1a	Boron	Yes	500	155	210	55 µg/L	11.00%
TC-1a	Chloride	Yes	230	19.5	23.4	3.9 mg/L	1.69%
TC-1a	Thallium	Yes	0.56	< 0.02	0.008	0.008 µg/L	1.42%
TC-1a	pH	Yes	6 to 9	7.9	8.4	0.5 $\log_{10}$	---
TC-1a	Copper	Yes	9.3	0.8	0.87	0.07 µg/L	0.75%

Designated uses in classes other than Class 2 are subject to protection to ensure the maintenance of any existing beneficial use. MPCA found that uses in other use classes will be met by both the FEIS concentrations and the design model concentrations, including the Class 3 hardness standard and the Class 4A sodium, bicarbonate, total dissolved solids, specific conductance and pH water quality standards. See Minn. R. 7050.0223, 7050.0224. The proposed project will cut off movement of existing polluted groundwater. As a result, the headwaters of Second Creek, Trimble Creek and Unnamed Creek will experience an improvement in water quality for sulfate and salty parameters when treated effluent is discharged to those locations.

Bioaccumulative chemicals of concern

The only bioaccumulative chemical of concern in the effluent is mercury. The net loading of mercury will be prudently and feasibly minimized using the best available treatment technologies. The effluent from the wastewater treatment system is expected to be at or below the water quality standard of 1.3 ng/L and will not cause or contribute to any downstream mercury water quality exceedance. The receiving water wetlands and downstream creeks are not listed as impaired for mercury under Section 303(d) of the Clean Water Act; however, observed values in the downstream creeks are periodically in excess of applicable water quality standards (1.3 ng/L), primarily as a result of atmospheric deposition (Section 8.1 (pp. 83-84) of the Antidegradation Evaluation). Existing water quality with respect to mercury is discussed in Section 8.2 (pp. 84-85) of the Antidegradation Evaluation. Section 8.3 (pp. 85-93) of the Antidegradation Evaluation provides a comparison of existing and estimated water quality for mercury due to the project. All downstream waters are expected to show no measurable increase in estimated mercury concentrations or loading as compared to existing conditions. Additionally, because of flow (and resulting mercury loading) reductions to the Partridge River from the project upstream of the confluence with Second Creek, the overall loading of mercury to the Partridge River (and to the St. Louis River) downstream of Second Creek is estimated to decrease from current conditions. Because of the net decrease, all downstream OIRWs and ORVWs, including Lake Superior, will be protected.

Conclusions on existing uses

The Antidegradation Evaluation conducted by PolyMet used the conservatively high effluent concentrations from the FEIS to ensure the Evaluation was protective of all existing water quality standards and designated uses. The PolyMet analysis did not rely on the lower effluent concentrations that resulted from the subsequent engineering design modeling. MPCA considered both sources of data and found all projected effluent concentrations will be below water quality standards according to both the FEIS effects analysis and the projected engineering design modeling. MPCA used different methods to determine measurable changes from existing water quality, but reached the same conclusion as PolyMet's Antidegradation Evaluation. The MPCA does not anticipate the proposed discharge, in combination with any other discharges to the receiving waters, will cause an exceedance of any water quality standard. Because the WWTS effluent will be below water quality standards, the discharge will not cause or contribute to an exceedance of a water quality standard in immediate receiving waters or downstream waters, including waters protected for drinking water use.

A prudent and feasible alternative that minimizes degradation exists and degradation will be minimized

Minn. R. 7050.0265 subp. 5 – Protection of surface waters of high quality.

A. *The commissioner shall not approve a proposed activity when the commissioner makes a finding that prudent and feasible prevention, treatment, or loading offset alternatives exist that would avoid degradation of existing high water quality. When the commissioner finds that prudent and feasible prevention, treatment, or loading offset alternatives are not available to avoid degradation, a proposed activity shall be approved only when the commissioner makes a finding that degradation will be prudently and feasibly minimized.*

The definition of water "of high quality" only applies to Class 2 water quality standards. Minn. R. 7050.0255 subp. 21. The receiving and downstream waters of the project all qualify as "high quality water" for one or more parameters. The MPCA has determined there is no prudent and feasible prevention, treatment, or loading offset alternative available to completely avoid degradation of these waters. The only way the project could eliminate degradation would be to not discharge any water at all. In order to not discharge any water, PolyMet would have to use imprudent and infeasible treatment technologies, such as evaporation and crystallization, which are extremely energy-intensive and would produce large volumes of waste that would need disposal at a landfill. The chosen prudent and feasible treatment alternative minimizes degradation to such an extent that it would be infeasible and imprudent to require more stringent treatment, such as zero water discharge.

The proposed discharge would contain pollutants, but the proposed treatment is a feasible and prudent alternative that will reduce pollutant concentrations more than any other feasible and prudent alternative, resulting in concentrations of most pollutants below detection limits and each pollutants respective water quality standard. As a result, the degradation is minimized. An analysis of alternatives that minimize net increases in loading of all relevant parameters of concern was performed, and an alternative that prudently and feasibly minimizes degradation was identified to manage all the parameters of concern. The parameters of concern are those parameters that have numeric water quality standards in Minn. R. 7050 and Minn. R. 7052 (including whole effluent toxicity standards). A summary of the alternative analysis process is in Sections 7.4 (pp. 70-77) and 9.3 (pp. 96-99) of the Antidegradation Evaluation. PolyMet's antidegradation alternative analysis relies primarily on the alternatives evaluated in the FEIS. The alternatives evaluation conducted during the environmental review process considered a wide range of pollution minimization strategies to reduce project impacts, including those related to the proposed discharge. These strategies include:

- Backfilling all of the highest sulfur (Category 4 and Category 2/3) waste rock into the mined-out East and Central pits, which will then be flooded for subaqueous disposal to minimize the release of contaminants from the waste rock and consequently the loading of contaminants to the WWTS. Previously this material had been proposed for permanent storage in surface stockpiles.
- Replacement of permanent stockpiles of Category 2/3 and Category 4 waste rock with temporary stockpiles that will be removed after the first 11 years of mining. The stockpiles will include engineered liner systems with a compacted low permeability subgrade, a geomembrane barrier layer and an overliner drainage layer to convey any leachate to the mine site wastewater collection system. The design of the liner system, as shown by modeling, will capture leachate generated by the stockpile;
- An enhanced geomembrane cover system for the Category 1 stockpile to replace the previously proposed soil cover. This will minimize long-term water flow through the stockpile resulting in substantial reduction of stockpile seepage volumes to be treated;
- Incorporation of groundwater collection system encompassing the entire low-sulfur Category 1 waste rock pile that will capture greater than 90% of groundwater and surface seepage from the stockpile for subsequent treatment. The original design for the Category 1 stockpile did not include a groundwater/seepage collection system;
- Bentonite addition to the Tailings Basin dams, beaches and pond bottom to reduce infiltration into the tailings and the amount of seepage wastewater generated;
- Incorporation of a seepage capture system at the Tailings Basin which is designed to capture nearly all of the seepage from the basin (from both NorthMet tailings and from existing LTV tailings) for subsequent treatment prior to discharge;

- Pretreatment of Mine Site water to reduce pollutant loadings to the Tailings Basin and to increase the suitability of Tailings Basin water for reuse in the processing circuit; and
- Installation of an advanced state-of-the-art wastewater treatment system that will utilize a combination of nanofiltration and reverse osmosis treatment technologies. This treatment technology treats wastewater to a much higher degree than more conventional chemical precipitation technologies.

The MPCA's review of the Antidegradation Evaluation presented in the NPDES/SDS permit application focused on the proposed discharge from the Plant Site WWTS. For the duration of the first permit cycle, and for at least the proposed active mining period of the project, this will be the only process water discharge to surface waters authorized under this permit. The draft NPDES/SDS permit contains an express prohibition against mine water or process water discharge to surface waters from the Mine Site. During this operational period, process wastewater from the Mine Site (e.g., mine pit dewatering and stockpile seepage collection) will be captured and routed to the Plant Site for pretreatment prior to use in the processing circuit, including storage/disposal in the Plant Site Tailings Basin. As a result, water from the Mine Site will be a component of the water collected by the Tailings Basin seepage capture system, which will then be treated and discharged from the Plant Site WWTS as authorized by the permit.

Because of this incorporation of Mine Site wastewater into the Plant Site water flowsheet, the MPCA considered Mine Site design and alternatives in its review of the Antidegradation Evaluation for the proposed discharge at the Plant Site. MPCA considered the design of Mine Site infrastructure (including stockpile liners and seepage collection systems), waste rock management during mining operations and the degree of pretreatment provided for Mine Site wastewater at the WWTS. The review included an assessment of the design changes and improvements identified above that were incorporated into the proposed project during the FEIS process to avoid or minimize potential impacts.

Collectively, the incorporation of these components into the project design at the Mine Site will minimize the release of pollutants from the Mine Site, which significantly contributes to the minimization of impacts from the proposed WWTS discharge at the Plant Site.

The analysis complies with the alternative analysis process described in Minnesota Rule 7050.0280 subpart 2, and 7052.0320 subparts 2 and 3. The MPCA finds that there are no prudent and feasible alternatives, including pollution prevention or alternative technology, to completely avoid degradation of downstream receiving waters. The MPCA's review focused on an evaluation of PolyMet's selection of a treatment system that avoids and minimizes the potential degradation (considered Best Technology in Process in Treatment, or BTPT, for purposes of bioaccumulative chemicals of concern). The combined water management and wastewater treatment system alternatives analysis described above also complies with the requirements to identify alternatives for bioaccumulative chemicals of concern and BTPT. PolyMet selected the BTPT for its proposed treatment system.

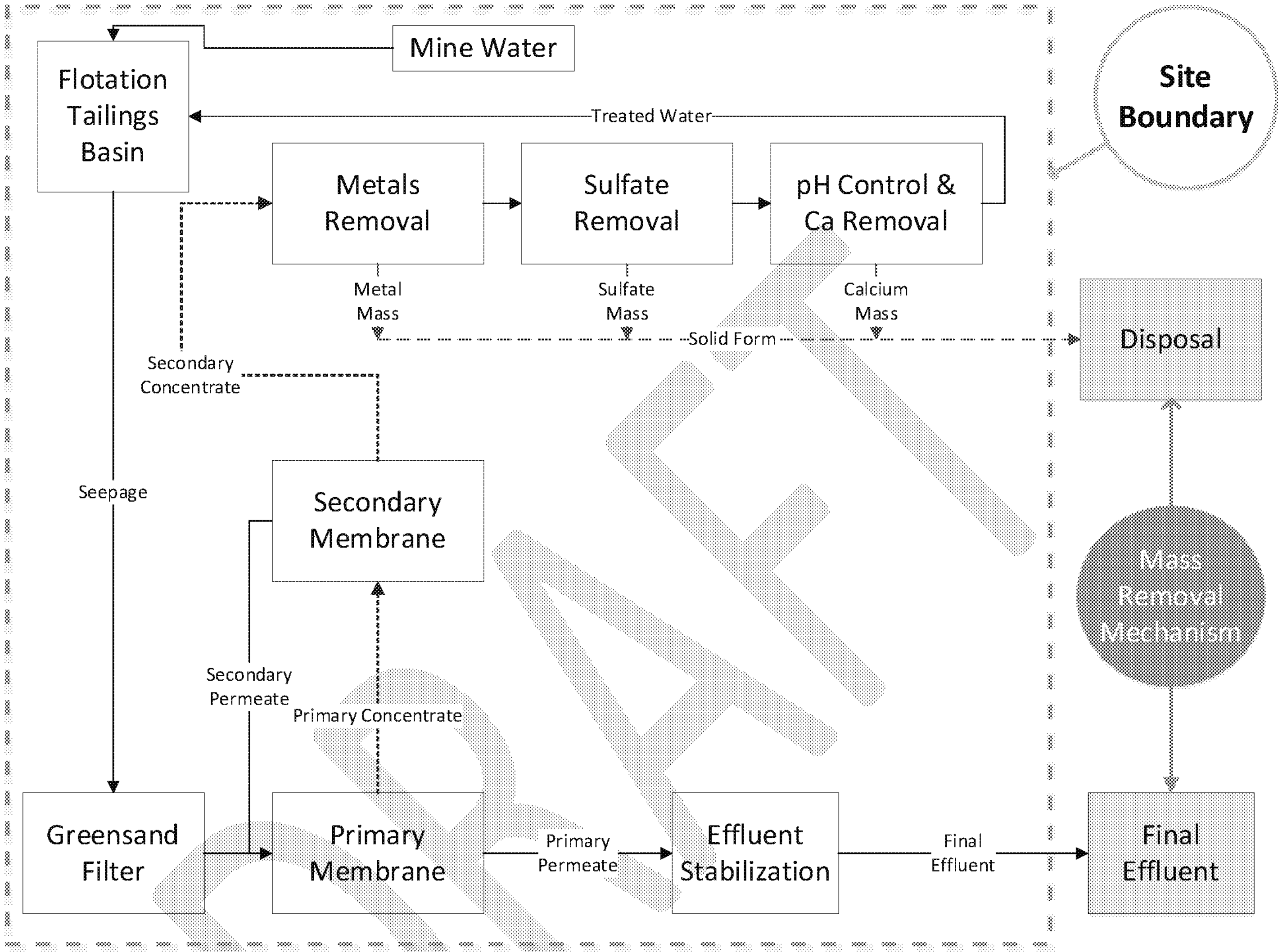
PolyMet has selected a combined water management and wastewater treatment system that will minimize or eliminate pollutant loading to the receiving waters. The selected design utilizes proven technology and has been demonstrated to be effective in project-specific pilot testing. The controlling design criterion is that the combined water management and treatment system consistently achieves a sulfate concentration of 10 mg/L or less in the effluent (Section 3.1.1 on pp. 19-20 of the Antidegradation Evaluation). The degree of treatment necessary to accomplish an effluent concentration of 10 mg/L sulfate will also result in the effective removal of other parameters of concern from the wastewater. So long as sulfate remains at or below 10 mg/L, the proposed treatment system will ensure other parameters are discharged in concentrations similar to the design model concentrations.

Membrane treatment works the same way as a filter, in that a membrane has microscopic holes that allow the water molecules to pass through but retains the targeted constituent on one side of the membrane. A membrane "rejects" molecules – not allowing them to pass through – primarily based on molecular size and ionic charge. As the size and charge of the molecule increase, the membrane tends to reject the molecules to a greater extent. Sulfate is typically rejected across a membrane at >95%, depending on the type of membrane. The rate of sulfate rejection used in modeling was established based on the results of pilot testing at >99% and information from membrane vendors in support of long-term performance. The sulfate rejection rate is comparable to the rejection rate of other parameters of concern, such as heavy metals, because of their size and/or charge. Thus, treating sulfate to low levels (< 10 mg/L) will also treat many other parameters of concern to low levels.

A simplified diagram of the treatment system necessary to achieve less than 10 mg/L sulfate is below in Figure 3. The orange site boundary dashed line represents the physical boundary of the entire proposed site. There are three ways pollutant mass can leave the system: 1) in the effluent in aqueous form 2) for disposal in solid form or 3) as a value-added product in solid form. To minimize pollutant mass in the effluent in aqueous form, it is necessary to convert dissolved pollutant mass into solid form using chemical precipitation. If the WWTS was unable to remove this internal dissolved pollutant mass from the system in solid form, then pollutants would concentrate to unmanageable concentrations. The reason these pollutants would concentrate is because membrane treatment does not remove, eliminate or treat pollutant mass. Membranes only concentrate the pollutant into a smaller volume of water. Ultimately, this smaller volume needs to be treated separately to actually remove pollutant mass using methods such as chemical precipitation.

For this treatment system, primary membrane treatment acts as the final barrier that redirects pollutants (such as sulfate and metals) and prevents them from leaving in the effluent. The primary membrane sends the pollutants to a chemical precipitation treatment chain that removes them from the system. Consequently, the ability of the membrane treatment system to redirect pollutants is essential to the function of the entire treatment system.

Figure 3. Simplified diagram of the proposed WWTS that emphasizes the three ways mass of parameters of concern could leave the system.



The design of the wastewater treatment system, which includes chemical precipitation and membrane treatment, will minimize or eliminate (i.e., to a level below method detection limits in most cases) the concentration of parameters of concern in the effluent. During bench and pilot testing of the membrane treatment system, PolyMet discovered that achieving a sulfate concentration of 10 mg/L or less in the effluent also resulted in the removal of other constituents in the wastewater – such as metals and salty parameters (e.g., calcium, hardness and alkalinity) – to very low levels (Attachment A of the Waste Water Treatment System: Design and Operations Report). In fact, the level of treatment required to achieve a sulfate concentration of 10 mg/L or less in the effluent removes all parameters of concern to such a degree that stabilizing constituents essential for aquatic life, such as calcium and alkalinity, must be added back to the internal waste stream as part of the treatment process to pass Whole Effluent Toxicity (WET) testing requirements. This is a demonstration of how intensive the pollution minimization system is and how the treatment system is designed to ensure that minimal degradation will occur in the receiving waters for all parameters of concern.

The MPCA determined that assessing for degradation in the immediate receiving water addresses degradation in downstream waters. This is because the immediate receiving water has the least amount of flow dilution available and the amount of assimilative capacity available in the receiving water increases as flow increases. Consequently, the magnitude of concentration change from the proposed discharge will decrease as the receiving waters flow farther downstream and flow rate increases. This makes assessing for degradation at the immediate receiving water the most sensitive or protective location to assess degradation for downstream waters. Because the immediate receiving waters would experience minimal degradation and all water quality standards would be met before any dilution, any downstream waters with higher flows would also experience minimal or no degradation.

The project is necessary to accommodate important economic or social development

Minn. R. 7050.0265 subp. 5 – Protection of surface waters of high quality.

B. *The commissioner shall approve a proposed activity only when the commissioner makes a finding that lower water quality resulting from the proposed activity is necessary to accommodate important economic or social changes in the geographic area in which degradation of existing high water quality is anticipated. The commissioner shall consider the following factors in determining the importance of economic or social changes:*

(1) economic gains or losses attributable to the proposed activity, such as changes in the number and types of jobs, median household income, productivity, property values, and recreational, tourism, and other commercial opportunities;

Section 7.5.1 (pp. 78-79) of the Antidegradation Evaluation describes direct and indirect employment that will result from the project, tax generation (federal, state and local), direct value to the State economy in the form of wages and rents, and the direct output value of the extracted minerals. These values are considerable particularly in the context of the relatively depressed economic conditions of the area.

(2) contribution to social services;

Section 7.5.2 (page 79) of the Antidegradation Evaluation describes the local and state tax revenue resulting from the proposed project, which will benefit local social services, local governments and area school systems.

(3) prevention or remediation of environmental or public health threats;

As discussed in Section 7.5.3 (pp. 79) of the Antidegradation Evaluation, construction of the proposed project will remediate an existing water quality issue at the Plant Site, which has not operated for more than 15 years. The project will capture seepage from the former LTVSMC tailings basin that was used in taconite operation, and will provide treatment of that captured tailings basin seepage through an advanced wastewater treatment system resulting in a net reduction of sulfate loading to the Embarrass River watershed of approximately 1600 tons per year, as well as removal of a variety of other constituents. The project is also predicted to result in a small net reduction of mercury loading to the St. Louis River watershed.

(4) trade-offs between environmental media; and

As described in Section 7.5.4 (page 80) of the Antidegradation Evaluation, the proposed project has been designed to minimize any degradation of water quality resulting from the project while at the same time addressing the environmental effects related to water quantity issues. The proposed capture of basin seepage could reduce water quantity in streams and wetlands downgradient of the Tailings Basin. These waters will be augmented with treated wastewater as necessary to maintain existing hydrology. In addition, the location of facility infrastructure such as waste rock stockpiles and mine roads has been designed to minimize impact to wetlands. In general, the proposed treatment will have relatively small impact to other environmental media. Any impacts would primarily be limited to the generation of non-hazardous wastewater treatment residuals (to be disposed of at permitted off-site solid waste facilities and/or the on-site Hydrometallurgical Residue Facility) and air quality effects related to the additional electrical demand for the wastewater treatment system obtained from natural gas and/or coal-fired sources from an off-site power generator.

(5) the value of the water resource, including:

(a) the extent to which the resources adversely impacted by the proposed activity are unique or rare within the locality, state, or nation;

(b) benefits associated with high water quality for uses such as ecosystem services and high water quality preservation for future generations to meet their own needs; and

(c) factors, such as aesthetics, that cannot be reasonably quantified; and

As described in Section 7.5.5 (pp. 80-81) of the Antidegradation Evaluation, the receiving waters and downstream segments of Second Creek, Trimble Creek and Unnamed Creek are not unique or rare locally, within Minnesota or in the United States. With the capture of seepage from the existing ferrous tailings basin, the proposed project is expected to improve the quality of waters downstream from the discharge and benefits associated with high water quality such as ecosystem services should be improved for the future.

(6) other relevant environmental, social, and economic impacts of the proposed activity.

A mineral deposit of this type and size is an uncommon geologic occurrence and the metals in the deposit are needed locally, nationally and globally for a variety of uses. Furthermore, the location of the proposed mineral resource is geologically constrained and cannot be moved elsewhere.

In summary, Section 7.5 (pp. 77-81) of the Antidegradation Evaluation describes the social and economic changes expected from the project as required by rule. Minn. R. 7050.0265; 7052.0320 subp. 2. The social and economic analysis considers economic gains, contributions to social services, prevention or remediation of environmental or public threats, trade-offs between environmental media and the value of the water resources as required in Minn. R. 7050.0265 Subpart 5(b). The social and economic analysis uses the same reasoning and draws the same conclusions as those presented in the FEIS. The analysis appropriately demonstrates that the expected economic and social benefits of the project are important, and the minimal degradation in receiving water quality is necessary to accommodate those benefits.

Protection of restricted outstanding resource value waters

Minn. R. 7050.0265, Subp. 6 - Protection of restricted outstanding resource value waters.

The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

The nearest downstream restricted Outstanding Resource Value Water (ORVW) is Lake Superior. As discussed in Sections 7.6 (page 82) and 6.3.6 (page 65) of the Antidegradation Evaluation, a mass balance calculation showed the project will have no measurable effect on water quality in the St. Louis River at Scanlon, prior to the river's entry into Lake Superior. As a result, there would be no measurable effect at Lake Superior. With the selection of the alternative that prudently and feasibly minimizes impacts with respect to facility design and wastewater treatment and the incorporation into the permit of protective limitations, monitoring and other requirements, the proposed activity will be restricted as necessary to preserve the existing water quality to protect Lake Superior.

Protection of prohibited outstanding resource value waters

Minn. R. 7050.0265, Sub. 7 - Protection of prohibited outstanding resource value waters.

The commissioner shall prohibit a proposed activity that results in a net increase in loading or other causes of degradation to prohibited outstanding resource value waters identified under part 7050.0335, subparts 3 and 4.

There are no downstream prohibited ORVWs.

Protection against impairments associated with thermal discharges

Minn. R. 7050.0265, Subp. 8 - Protection against impairments associated with thermal discharges.

When there is potential for water quality impairment associated with thermal discharges, the commissioner's allowance for existing water quality degradation shall be consistent with section 316 of the Clean Water Act, United States Code, title 33, section 1326. When a variance is granted under section 316(a) of the Clean Water Act, United States Code, title 33, section 1326, antidegradation standards under this part still apply.

As discussed in section 7.7 of the Antidegradation Evaluation (page 82), the treatment process will add minimal heat to the water and the discharge will be approximately the same temperature as shallow groundwater. No thermal impacts are expected.

Antidegradation Demonstration for New Discharges in the Lake Superior Basin

Minn. R. 7052.0320 requires an antidegradation demonstration for any discharger proposing a new or expanded discharge of a bioaccumulative substance of immediate concern (BSIC) to an outstanding international resource water (OIRW). PolyMet's proposed discharge of treated wastewater containing mercury (a BSIC) to streams within the St. Louis River watershed meets this criterion. The antidegradation demonstration requires an analysis to identify cost-effective pollution prevention alternatives and treatment techniques that would eliminate or reduce the extent of increased loading of mercury and lowering of water quality. As a discharger proposing a new loading of a BSIC to an OIRW, PolyMet must also provide an analysis of Best Technology in Process and Treatment (BTPT).

PolyMet included an analysis of BTPT in Section 9.3 (pp. 96-99) of the Antidegradation Evaluation. Additional design considerations and constraints, expected performance, and reliability of the least degrading alternative are described in Section 3.0 of the Waste Water Treatment System: Design and Operations Report for the NorthMet project (pp. 13-35). <Link>. Together, these reports provided information on opportunities and technologies the discharger has to minimize the generation of mercury and reduce the loadings in the discharge. The analysis identifies many of the same alternatives and techniques as those described above for non-BSIC pollutants. As identified in the "Existing Uses" section starting on page 8 above, the selection and incorporation of advanced state-of-the-art treatment technology into the project design will minimize the lowering of water quality. The expected performance of the system is based on a combination of engineering design, modeling, redundancy of critical treatment components and physical testing of the systems at the bench and pilot scale. Additional project considerations beyond state-of-the-art treatment include a lower mercury content of NorthMet tailings as compared to existing LTV tailings and the demonstrated mercury filtration capabilities of both NorthMet and LTV tailings. The facility and wastewater treatment system design satisfies the requirements of BTPT in Minn. R. 7052.0320 subp. 3.

Conclusion

Based upon the preliminary review of the information provided in the Antidegradation Evaluation, as well as other reliable information available to the commissioner concerning the proposed activity and other activities that cause cumulative changes in existing water quality in the surface waters, the MPCA has made a preliminary determination that the proposed activity satisfies the standards in Minnesota Rules 7050.0265 and 7052.0300, as well as federal surface water pollution control statutes and rules administered by the commissioner.

References

EPA ProUCL Version 5.1 User Guide. https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf

Wastewater Treatment System: Design and Operation Report v2 (wq-wwprm1-41b) ftp://files.pca.state.mn.us/pub/file_requests/Polymet/wq-wwprm1-51b.pdf

NPDES/SDS Permit Application Vol III – Waste Water Treatment System https://www.pca.state.mn.us/sites/default/files/wq-wwprm1-50w.pdf

NPDES/SDS Permit Application Vol V – Tailing Basin and Beneficiation Plant

https://www.pca.state.mn.us/sites/default/files/wq-wwprm1-50y.pdf

Antidegradation rulemaking: Attachment 1 to MPCA Post-Hearing Response to Public Comments MPCA Detailed Responses to Public Comments https://www.pca.state.mn.us/sites/default/files/wq-rule3-60j.pdf

Attachment A

This excel document titled:

PolyMet Antideg Measurable Change d4.xlsx

file:///X:\Agency_Files\Water\Standards\Effluent%20Limit%20Review%20Documents\Industrial-Other_TEST\MN0071013%20Polymet\2016\PolyMet%20Antideg%20Measureable%20Change%20d4.xlsx

Attachment B: NorthMet Antidegradation Evaluation Statistical Supplement Methods Summary

MPCA has requested that PolyMet consider statistically evaluating certain datasets with non-detect values using either a nonparametric method (e.g., Kaplan Meier) or a parametric method, when appropriate, rather than using statistical substitution methods. MPCA also requested calculation of the 95% upper confidence limit (UCL) of the mean of baseline data for certain datasets.

In response, PolyMet has evaluated the Antidegradation Evaluation datasets using the ProUCL software, which was developed for the USEPA specifically to analyze datasets that include non-detect values. Table 1 summarizes the methods that PolyMet used in this exercise requested by MPCA to determine a measure of central tendency (an average or an alternate measure for datasets for which there may be limitations affecting calculations of averages). Table 2 summarizes the methods that PolyMet used in this exercise requested by MPCA to determine the 95% UCL. PolyMet used site-specific approaches for datasets with high frequency of non-detects (USEPA 2015, pg. 31).

Table 1 Summary of Non-Substitution Approaches for Measures of Central Tendency

Sample Size	Non-Detect Frequency	Measure of Central Tendency	Citations
All	0%	Arithmetic mean	For datasets with no non-detects, the Kaplan-Meier mean is equal to the arithmetic mean (Helsel 2012)
	≤50%	Kaplan-Meier mean	• Kaplan Meier recommended (USEPA 2009, pg. 15-3) *"The guidance generally favors the use of the ...Kaplan-Meier or Robust ROS* [regression on order statistics] *methods which can address the problem of multiple detection limits"* • Robust ROS ruled out (USEPA 2009, p 8-24) Robust ROS underlying assumptions: *"Data must be normal or normalized..."* • Limit at 50% non-detects (USEPA 2009, pg 8-23) *"Kaplan-Meier should not be used when more than 50% of the data are non-detects."*
	>51%	Median value. If median is a non-detect, report as a less-than value[1]	• Site-specific method (USEPA 2015, sec. 1.12): *"For data sets with low detection frequencies, other measures such as the median or mode represent better estimates (with lesser uncertainty) of the population measure of central tendency."*

[1] For mass balance calculations, when the central tendency of the baseline data was a non-detect value, PolyMet used the median detection limit as the baseline concentration to which Project loading was added.

(USEPA 2009) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530/R-09-007. March 2009.

(USEPA 2015) ProUCL Version 5.1.002 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. October 2015.

(Helsel 2012) Statistics for Censored Environmental Data Using Minitab and R 2nd Ed. John Wiley & Sons, Inc., Hoboken, NJ.

Table 2 Summary of Approaches for Calculation of 95% UCLs

Sample Size	Non-Detect Frequency	95% UCL Method	Citation for recommended 95% UCL approach
All	<100%	ProUCL recommended 95% UCL, or highest detected value[(1)] if: 1) ProUCL program indicates that there are too few detects to calculate a 95%UCL; or, 2) the recommended UCL is less than the median	• Basic approach (USEPA 2015, Sec 1.10) *"ProUCL computes 95% UCLs of the mean using several methods based upon normal, gamma, lognormal, and non-discernible distributions."* • Description of how ProUCL evaluates dataset and recommends a UCL method (USEPA 2015, Sec. 4.6) • Use of highest detected value when there are too few detects to calculate a UCL (USEPA 2015, Sec.1.10.) *"Some practitioners use the maximum detected value as an estimate of the EPC term... when the sample size is small or when a UCL95 exceeds the maximum detected value."*
	100%	Maximum reporting limit	• Approach if 100% non-detects (USEPA 2015; Sec. 1.12): *"...when all of the sampled values are reported as NDs, the [UCL] and other statistical limits should also be reported as a ND* [non-detect] *value, perhaps by the maximum RL* [reporting limit] *or the maximum RL/2. The project team will need to make this determination"*

(1) Highest non-detect value used if highest detect value is less than median.

(USEPA 2015) ProUCL Version 5.1.002 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. October 2015.

Other reference materials reviewed for this analysis included the following:

- ITRC, 2013. ITRC Guidance Document: Groundwater Statistics and Monitoring Compliance.
- USEPA, 2006. Data Quality Assessment: Statistical Methods for Practitioners. EPA QA/G-9S; EPA/240/B-06/003. February, 2006.
- USEPA, 2006. On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations. EPA/600/R-06/022. Singh, Maichle, and Lee. March, 2006.

ProUCL Results

Baseline Water Quality at Antidegradation Evaluation Monitoring Locations

			All data, nd @ DL														Selected Central Tendency				Selected UCL		
Location	**Parameter**	**Units**	**n**	**detects**	**nd**	**% ND**	**min ND**	**max ND**	**KM mean**	**min D**	**max D**	**Arith Mean**	**Median**	**Raw UCL**	**Description**	**Distribution**	**Flag**	**Value**	**Value Adj Units (ug/L)**	**Method**	**Value**	**Value Adj Units (ug/L)**	**Method**
MNSW12 / USGS 04016000	**Aluminum, total**	**mg/L**	10	10	0	0%	N/A	N/A	1.05E-01	0.0293	0.171	1.05E-01	0.12	1.36E-01	95% Student's-t UCL	Normal		1.05E-01	105	Arith Mean	1.36E-01	1.36E+02	95% UCL
	Antimony, total	**mg/L**	7	6	1	14%	0.0005	0.0005	9.07E-05	0.00005	0.00011	1.49E-04	0.000099	1.09E-04	95% KM (t) UCL	Normal		9.07E-05	0.09	KM Mean	1.09E-04	1.09E-01	95% UCL
	Arsenic, total	**mg/L**	10	7	3	30%	0.002	0.002	9.91E-04	0.00066	0.0017	1.29E-03	0.0011	1.24E-03	95% KM (t) UCL	Normal		9.91E-04	0.99	KM Mean	1.24E-03	1.24E+00	95% UCL
	Boron, total	**mg/L**	8	8	0	0%	N/A	N/A	1.01E-01	0.0594	0.15	1.01E-01	0.1003	1.22E-01	95% Student's-t UCL	Normal		1.01E-01	101	Arith Mean	1.22E-01	1.22E+02	95% UCL
	Cadmium, total	**mg/L**	8	1	7	88%	0.0002	0.0002	3.20E-05	0.000032	0.000032	1.79E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	0.20	Median	2.00E-04	2.00E-01	Max ND
	Chromium, total	**mg/L**	8	5	3	38%	0.001	0.001	5.84E-04	0.00038	0.00095	7.40E-04	0.000775	N/A	Insufficient detects for UCL	N/A		5.84E-04	0.58	KM Mean	9.50E-04	9.50E-01	Max D
	Cobalt, total	**mg/L**	8	8	0	0%	N/A	N/A	4.59E-04	0.00028	0.00073	4.59E-04	0.000445	5.49E-04	95% Student's-t UCL	Normal		4.59E-04	0.46	Arith Mean	5.49E-04	5.49E-01	95% UCL
	Copper, total	**mg/L**	8	8	0	0%	N/A	N/A	3.35E-03	0.0019	0.0048	3.35E-03	0.0034	4.01E-03	95% Student's-t UCL	Normal		3.35E-03	3.35	Arith Mean	4.01E-03	4.01E+00	95% UCL
	Lead, total	**mg/L**	8	6	2	25%	0.0005	0.0006	2.72E-04	0.000054	0.00046	3.42E-04	0.00041	4.08E-04	95% KM (t) UCL	Normal		2.72E-04	0.27	KM Mean	4.08E-04	4.08E-01	95% UCL
	Nickel, total	**mg/L**	8	8	0	0%	N/A	N/A	3.63E-03	0.0027	0.0046	3.63E-03	0.00355	4.00E-03	95% Student's-t UCL	Normal		3.63E-03	3.63	Arith Mean	4.00E-03	4.00E+00	95% UCL
	Selenium, total	**mg/L**	8	7	1	13%	0.001	0.001	5.74E-04	0.00033	0.00099	6.28E-04	0.00057	7.26E-04	95% KM (t) UCL	Normal		5.74E-04	0.57	KM Mean	7.26E-04	7.26E-01	95% UCL
	Silver, total	**mg/L**	8	4	4	50%	0.0002	0.0002	6.38E-06	0.0000058	0.0000074	1.03E-04	0.0001037	N/A	Insufficient detects for UCL	N/A		6.38E-06	0.01	KM Mean	7.40E-06	7.40E-03	Max D
	Thallium, total	**mg/L**	7	0	7	[redacted]	0.0004	0.0004	N/A	N/A	N/A	4.00E-04	0.0004	N/A	Insufficient detects for UCL	N/A	<	4.00E-04	0.40	Median	4.00E-04	4.00E-01	Max ND
	Zinc, total	**mg/L**	16	16	0	0%	N/A	N/A	4.16E-03	0.001	0.0085	4.16E-03	0.0039	4.97E-03	95% Student's-t UCL	Normal		4.16E-03	4.16	Arith Mean	4.97E-03	4.97E+00	95% UCL
	Chloride	**mg/L**	19	19	0	0%	N/A	N/A	4.91E+00	2.66	8.24	4.91E+00	4.3	5.68E+00	95% Student's-t UCL	Nonparametric		4.91E+00		Arith Mean	5.68E+00		95% UCL
	Hardness, as CaCO3	**mg/L**	10	10	0	0%	N/A	N/A	2.91E+02	82.5	546	2.91E+02	236	3.88E+02	95% Student's-t UCL	Normal		2.91E+02		Arith Mean	3.88E+02		95% UCL
	pH	**S.U.**	11	11	0	0%	N/A	N/A	7.61E+00	7.29	7.88	7.61E+00	7.62	7.71E+00	95% Student's-t UCL	Normal		7.61E+00		Arith Mean	7.71E+00		95% UCL
	Solids, total dissolved	**mg/L**	10	10	0	0%	N/A	N/A	3.75E+02	137	650	3.75E+02	300	4.90E+02	95% Student's-t UCL	Normal		3.75E+02		Arith Mean	4.90E+02		95% UCL
	Specific Conductance @ 25	**uS/cm**	11	11	0	0%	N/A	N/A	5.99E+02	189	1173	7.93E+02	824.3	7.92E+02	95% Student's-t UCL	Normal		7.93E+02		Arith Mean	1.17E+03		Max D
	Sulfate, as SO4	**mg/L**	10	10	0	0%	N/A	N/A	1.64E+02	43	302	1.64E+02	127.5	2.24E+02	95% Student's-t UCL	Normal		1.64E+02		Arith Mean	2.24E+02		95% UCL
	Mercury, total	**ng/L**	3	3	0	0%	N/A	N/A	4.67E+00	2.2	9.5	4.67E+00	2.3	N/A	Insufficient detects for UCL	N/A		4.67E+00		Arith Mean	9.50E+00		Max D
MNSW8	**Aluminum, total**	**mg/L**	12	12	0	0%	N/A	N/A	5.98E-02	0.0264	0.187	5.98E-02	0.04965	1.13E-01	95% Chebyshev(Mean, Sd) UCL	Nonparametric		5.98E-02	5.98E+01	Arith Mean	1.13E-01	1.13E+02	95% UCL
	Antimony, total	**mg/L**	8	7	1	13%	0.0005	0.0005	6.36E-05	0.00004	0.0001	1.18E-04	0.0000715	8.04E-05	95% KM (t) UCL	Normal		6.36E-05	6.36E-02	KM Mean	8.04E-05	8.04E-02	95% UCL
	Arsenic, total	**mg/L**	12	7	5	42%	0.002	0.002	1.64E-03	0.0011	0.0029	1.90E-03	0.002	1.97E-03	95% KM (t) UCL	Normal		1.64E-03	1.64E+00	KM Mean	1.97E-03	1.97E+00	95% UCL
	Boron, total	**mg/L**	8	8	0	0%	N/A	N/A	8.50E-02	0.0536	0.113	8.50E-02	0.0896	9.95E-02	95% Student's-t UCL	Normal		8.50E-02	8.50E+01	Arith Mean	9.95E-02	9.95E+01	95% UCL
	Cadmium, total	**mg/L**	8	2	6	75%	0.0002	0.0002	4.30E-05	0.000042	0.000044	1.61E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.00E-04	2.00E-01	Max ND
	Chromium, total	**mg/L**	8	6	2	25%	0.001	0.001	5.72E-04	0.00033	0.0012	7.01E-04	0.000635	7.90E-04	95% KM (t) UCL	Normal		5.72E-04	5.72E-01	KM Mean	7.90E-04	7.90E-01	95% UCL
	Cobalt, total	**mg/L**	8	8	0	0%	N/A	N/A	7.71E-04	0.00063	0.0011	7.71E-04	0.000715	8.81E-04	95% Student's-t UCL	Normal		7.71E-04	7.71E-01	Arith Mean	8.81E-04	8.81E-01	95% UCL
	Copper, total	**mg/L**	8	6	2	25%	0.0007	0.0007	7.75E-04	0.00067	0.0014	7.80E-04	0.000695	9.49E-04	95% KM (t) UCL	Nonparametric		7.75E-04	7.75E-01	KM Mean	9.49E-04	9.49E-01	95% UCL
	Lead, total	**mg/L**	8	5	3	38%	0.0005	0.0006	2.30E-04	0.000079	0.00094	3.94E-04	0.000345	N/A	Insufficient detects for UCL	N/A		2.30E-04	2.30E-01	KM Mean	9.40E-04	9.40E-01	Max D
	Nickel, total	**mg/L**	8	8	0	0%	N/A	N/A	5.73E-03	0.0037	0.0078	5.73E-03	0.0056	6.73E-03	95% Student's-t UCL	Normal		5.73E-03	5.73E+00	Arith Mean	6.73E-03	6.73E+00	95% UCL
	Selenium, total	**mg/L**	8	7	1	13%	0.001	0.001	7.74E-04	0.00043	0.0012	8.18E-04	0.0008	9.65E-04	95% KM (t) UCL	Normal		7.74E-04	7.74E-01	KM Mean	9.65E-04	9.65E-01	95% UCL
	Silver, total	**mg/L**	8	5	3	38%	0.0002	0.0002	8.32E-06	0.0000058	0.000012	8.02E-05	0.000011	N/A	Insufficient detects for UCL	N/A		8.32E-06	8.32E-03	KM Mean	1.20E-05	1.20E-02	Max D
	Thallium, total	**mg/L**	8	0	8	[redacted]	0.0004	0.0004	N/A	N/A	N/A	4.00E-04	0.0004	N/A	Insufficient detects for UCL	N/A	<	4.00E-04	4.00E-01	Median	4.00E-04	4.00E-01	Max ND
	Zinc, total	**mg/L**	16	15	1	6%	0.006	0.006	4.20E-03	0.00082	0.0078	4.36E-03	0.0044	5.08E-03	95% KM (t) UCL	Normal		4.20E-03	4.20E+00	KM Mean	5.08E-03	5.08E+00	95% UCL
	Chloride	**mg/L**	23	23	0	0%	N/A	N/A	8.45E+00	7.27	10.6	8.45E+00	8.4	8.76E+00	95% Student's-t UCL	Normal		8.45E+00		Arith Mean	8.76E+00		95% UCL
	Hardness, as CaCO3	**mg/L**	12	12	0	0%	N/A	N/A	8.06E+02	491	949	8.06E+02	883.5	8.87E+02	95% Student's-t UCL	Nonparametric		8.06E+02		Arith Mean	8.87E+02		95% UCL
	pH	**S.U.**	13	13	0	0%	N/A	N/A	7.76E+00	7.37	8.03	7.75E+00	7.8	7.84E+00	95% Student's-t UCL	Normal		7.75E+00		Arith Mean	7.84E+00		95% UCL
	Solids, total dissolved	**mg/L**	12	12	0	0%	N/A	N/A	9.49E+02	549	1260	9.49E+02	999.5	1.06E+03	95% Student's-t UCL	Normal		9.49E+02		Arith Mean	1.06E+03		95% UCL
	Specific Conductance @ 25	**uS/cm**	13	13	0	0%	N/A	N/A	1.32E+03	856.3	1665	1.32E+03	1409	1.44E+03	95% Student's-t UCL	Normal		1.32E+03		Arith Mean	1.44E+03		95% UCL
	Sulfate, as SO4	**mg/L**	12	12	0	0%	N/A	N/A	4.73E+02	269	624	4.73E+02	507	5.29E+02	95% Student's-t UCL	Normal		4.73E+02		Arith Mean	5.29E+02		95% UCL
	Mercury, total	**ng/L**	7	7	0	0%	N/A	N/A	4.03E+00	1.4	7.5	4.03E+00	3.9	5.64E+00	95% Student's-t UCL	Normal		4.03E+00		Arith Mean	5.64E+00		95% UCL
PM-11	**Aluminum, total**	**mg/L**	66	48	18	27%	0.01	0.04	2.99E-02	0.0104	0.119	3.26E-02	0.0283	3.40E-02	95% KM (t) UCL	Nonparametric		2.99E-02	2.99E+01	KM Mean	3.40E-02	3.40E+01	95% UCL
	Antimony, total	**mg/L**	35	0	35	[redacted]	0.0005	0.003	N/A	N/A	N/A	7.86E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	3.00E-03	3.00E+00	Max ND
	Arsenic, total	**mg/L**	58	35	23	40%	0.0005	0.002	9.24E-04	0.00051	0.0041	1.03E-03	0.000795	1.03E-03	95% KM H-UCL	Lognormal		9.24E-04	9.24E-01	KM Mean	1.03E-03	1.03E+00	95% UCL
	Boron, total	**mg/L**	23	22	1	4%	0.1	0.1	2.10E-01	0.109	0.307	2.10E-01	0.228	2.32E-01	95% KM (t) UCL	Normal		2.10E-01	2.10E+02	KM Mean	2.32E-01	2.32E+02	95% UCL
	Cadmium, total	**mg/L**	26	5	21	81%	0.00003	0.0002	3.35E-05	0.000021	0.000069	1.62E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.00E-04	2.00E-01	Max ND
	Chromium, total	**mg/L**	26	5	21	81%	0.001	0.001	5.98E-04	0.00033	0.0023	1.04E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	2.30E-03	2.30E+00	Max D
	Cobalt, total	**mg/L**	64	17	47	73%	0.0002	0.001	3.13E-04	0.00016	0.0076	4.16E-04	0.0002	8.31E-04	95% KM (Chebyshev) UCL	Nonparametric	<	2.00E-04	2.00E-01	Median	8.31E-04	8.31E-01	95% UCL
	Copper, total	**mg/L**	66	53	13	20%	0.0005	0.005	8.43E-04	0.0005	0.0023	1.07E-03	0.000795	9.21E-04	95% KM Adjusted Gamma UCL	Gamma		8.43E-04	8.43E-01	KM Mean	9.21E-04	9.21E-01	95% UCL
	Lead, total	**mg/L**	60	6	54	90%	0.0003	0.001	7.87E-05	0.00003	0.00015	4.80E-04	0.0005	1.11E-04	95% KM (t) UCL	Normal	<	5.00E-04	5.00E-01	Median	1.00E-03	1.00E+00	Max ND
	Nickel, total	**mg/L**	66	25	41	62%	0.0005	0.005	6.78E-04	0.00054	0.0017	9.50E-04	0.00057	7.44E-04	95% KM (t) UCL	Normal		5.70E-04	5.70E-01	Median	7.44E-04	7.44E-01	95% UCL
	Selenium, total	**mg/L**	42	3	39	93%	0.001	0.0036	4.53E-04	0.00024	0.00061	1.30E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	3.60E-03	3.60E+00	Max ND
	Silver, total	**mg/L**	21	0	21	[redacted]	0.0002	0.001	N/A	N/A	N/A	3.60E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	1.00E-03	1.00E+00	Max ND
	Thallium, total	**mg/L**	47	5	42	89%	0.0000004	0.002	1.60E-06	0.0000013	0.0000092	2.31E-04	0.0000075	N/A	Insufficient detects for UCL	N/A		7.50E-06	7.50E-03	Median	9.20E-06	9.20E-03	Max D
	Zinc, total	**mg/L**	66	7	59	89%	0.006	0.01	3.36E-03	0.0016	0.0412	7.01E-03	0.006	4.62E-03	95% KM (t) UCL	Normal	<	6.00E-03	6.00E+00	Median	4.12E-02	4.12E+01	Max D
	Chloride	**mg/L**	81	81	0	0%	N/A	N/A	1.70E+01	3.1	34.1	1.70E+01	16.5	1.86E+01	95% Student's-t UCL	Normal		1.70E+01		Arith Mean	1.86E+01		95% UCL
	Hardness, as CaCO3	**mg/L**	66	66	0	0%	N/A	N/A	3.73E+02	109	705	3.73E+02	349.5	4.07E+02	95% Student's-t UCL	Normal		3.73E+02		Arith Mean	4.07E+02		95% UCL
	pH	**S.U.**	76	76	0	0%	N/A	N/A	7.56E+00	6.64	8.3	7.56E+00	7.615	7.62E+00	95% Student's-t UCL	Normal		7.56E+00		Arith Mean	7.62E+00		95% UCL
	Solids, total dissolved	**mg/L**	66	66	0	0%	N/A	N/A	4.92E+02	186	927	4.92E+02	458.5	5.32E+02	95% Student's-t UCL	Normal		4.92E+02		Arith Mean	5.32E+02		95% UCL
	Specific Conductance @ 25	**uS/cm**	70	70	0	0%	N/A	N/A	7.93E+02	248	1386	7.93E+02	824.3	8.49E+02	95% Student's-t UCL	Normal		7.93E+02		Arith Mean	8.49E+02		95% UCL
	Sulfate, as SO4	**mg/L**	85	85	0	0%	N/A	N/A	1.15E+02	4.4	245	1.15E+02	106	1.46E+02	95% Chebyshev (Mean, Sd) UCL	Nonparametric		1.15E+02		Arith Mean	1.46E+02		95% UCL
	Mercury, total	**ng/L**	38	32	6	16%	0.5	10	1.73E+00	0.6	5.95	2.51E+00	1.6	2.10E+00	95% KM Adjusted Gamma UCL	Gamma		1.73E+00		KM Mean	2.10E+00		95% UCL
	Aluminum, total	**mg/L**	64	64	0	0%	N/A	N/A	1.81E-01	0.0439	0.72	1.81E-01	0.1305	2.52E-01	95% Chebyshev(Mean, Sd) UCL	Nonparametric		1.81E-01	1.81E+02	Arith Mean	2.52E-01	2.52E+02	95% UCL

	Antimony, total	mg/L	26	0	26	[redacted]	0.0005	0.003	N/A	N/A	N/A	8.85E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	3.00E-03	3.00E+00	Max ND
	Arsenic, total	mg/L	47	35	12	26%	0.0005	0.002	1.09E-03	0.00039	0.0025	1.19E-03	0.0011	1.27E-03	95% KM Adjusted Gamma UCL	Gamma		1.09E-03	1.09E+00	KM Mean	1.27E-03	1.27E+00	95% UCL
	Boron, total	mg/L	18	3	15	83%	0.035	0.1	4.47E-02	0.0449	0.0689	7.19E-02	0.05945	N/A	Insufficient detects for UCL	N/A		5.95E-02	5.95E+01	Median	6.89E-02	6.89E+01	Max D
	Cadmium, total	mg/L	21	2	19	90%	0.0002	0.0002	5.43E-05	0.000044	0.00026	1.95E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.60E-04	2.60E-01	Max D
	Chromium, total	mg/L	21	5	16	76%	0.001	0.001	1.01E-03	0.00071	0.0043	1.18E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	4.30E-03	4.30E+00	Max D
	Cobalt, total	mg/L	68	42	26	38%	0.0002	0.001	4.12E-04	0.00021	0.0011	6.05E-04	0.00049	4.55E-04	95% KM Adjusted Gamma UCL	Gamma		4.12E-04	4.12E-01	KM Mean	4.55E-04	4.55E-01	95% UCL
	Copper, total	mg/L	70	66	4	6%	0.0007	0.005	1.24E-03	0.00062	0.0023	1.41E-03	0.0012	1.31E-03	95% KM Adjusted Gamma UCL	Gamma		1.24E-03	1.24E+00	KM Mean	1.31E-03	1.31E+00	95% UCL
	Lead, total	mg/L	54	3	51	94%	0.0003	0.001	1.94E-04	0.00015	0.00063	5.20E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	6.30E-04	6.30E-01	Max D
	Nickel, total	mg/L	70	60	10	14%	0.0005	0.005	1.38E-03	0.00054	0.0027	1.59E-03	0.0014	1.50E-03	95% KM (t) UCL	Normal		1.38E-03	1.38E+00	KM Mean	1.50E-03	1.50E+00	95% UCL
PM-13	Selenium, total	mg/L	38	0	38	[redacted]	0.001	0.0036	N/A	N/A	N/A	1.38E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	3.60E-03	3.60E+00	Max ND
	Silver, total	mg/L	16	0	16	[redacted]	0.0002	0.001	N/A	N/A	N/A	4.10E-04	0.00022	N/A	Insufficient detects for UCL	N/A	<	2.20E-04	2.20E-01	Median	1.00E-03	1.00E+00	Max ND
	Thallium, total	mg/L	38	8	30	79%	0.0000004	0.002	3.29E-06	0.0000026	0.000019	2.68E-04	0.000005	5.14E-06	95% KM (t) UCL	Normal	<	5.00E-06	5.00E-03	Median	5.14E-06	5.14E-03	95% UCL
	Zinc, total	mg/L	98	11	87	89%	0.006	0.025	5.15E-03	0.0032	0.061	1.05E-02	0.006	4.98E-03	95% KM H-UCL	Lognormal	<	6.00E-03	6.00E+00	Median	6.10E-02	6.10E+01	Max D
	Chloride	mg/L	83	83	0	0%	N/A	N/A	6.98E+00	2	94.8	6.98E+00	5.08	1.19E+01	95% Chebyshev(Mean, Sd) UCL	Nonparametric		6.98E+00		Arith Mean	1.19E+01		95% UCL
	Hardness, as CaCO3	mg/L	68	68	0	0%	N/A	N/A	1.39E+02	35.6	337	1.39E+02	118	1.56E+02	95% Approximate Gamma UCL	Gamma		1.39E+02		Arith Mean	1.56E+02		95% UCL
	pH	S.U.	71	71	0	0%	N/A	N/A	7.38E+00	6.3	8.6	7.38E+00	7.33	7.47E+00	95% Student's-t UCL	Normal		7.38E+00		Arith Mean	7.47E+00		95% UCL
	Solids, total dissolved	mg/L	68	68	0	0%	N/A	N/A	2.27E+02	48	494	2.27E+02	210.5	2.48E+02	95% Approximate Gamma UCL	Gamma		2.27E+02		Arith Mean	2.48E+02		95% UCL
	Specific Conductance @ 25	uS/cm	71	71	0	0%	N/A	N/A	2.84E+02	42	698.2	2.84E+02	236.5	3.17E+02	95% Approximate Gamma UCL	Gamma		2.84E+02		Arith Mean	3.17E+02		95% UCL
	Sulfate, as SO4	mg/L	87	87	0	0%	N/A	N/A	5.14E+01	7.56	688	5.14E+01	28	8.85E+01	95% Chebyshev (Mean, Sd) UCL	Nonparametric		5.14E+01		Arith Mean	8.85E+01		95% UCL
	Mercury, total	ng/L	43	31	12	28%	2	10	3.43E+00	0.84	12.4	4.30E+00	3.6	4.18E+00	95% KM (t) UCL	Normal		3.43E+00		KM Mean	4.18E+00		95% UCL
	Aluminum, dissolved	mg/L	50	49	1	2%	0.01	0.01	1.01E-01	0.01	1	1.01E-01	0.05	2.09E-01	95% KM (Chebyshev) UCL	Nonparametric		1.01E-01	1.01E+02	KM Mean	2.09E-01	2.09E+02	95% UCL
	Antimony, total	mg/L	0																				
	Arsenic, dissolved	mg/L	67	44	23	34%	0.001	0.001	1.64E-03	0.001	0.02	1.64E-03	0.001	2.92E-03	95% KM (Chebyshev) UCL	Nonparametric		1.64E-03	1.64E+00	KM Mean	2.92E-03	2.92E+00	95% UCL
	Boron, dissolved	mg/L	91	91	0	0%	N/A	N/A	1.11E-01	0.01	0.28	1.11E-01	0.1	1.26E-01	95% Approximate Gamma UCL	Gamma		1.11E-01	1.11E+02	Arith Mean	1.26E-01	1.26E+02	95% UCL
	Cadmium, dissolved	mg/L	48	9	39	81%	0.001	0.002	1.71E-03	0.001	0.02	1.83E-03	0.001	1.67E-03	95% KM H-UCL	Lognormal	<	1.00E-03	1.00E+00	Median	1.67E-03	1.67E+00	95% UCL
	Chromium, dissolved	mg/L	50	26	24	48%	0.001	0.02	6.26E-03	0.001	0.02	7.24E-03	0.001	1.08E-02	95% KM (Chebyshev) UCL	Nonparametric		6.26E-03	6.26E+00	KM Mean	1.08E-02	1.08E+01	95% UCL
	Cobalt, dissolved	mg/L	52	2	50	96%	0.001	0.003	1.12E-03	0.003	0.005	2.83E-03	0.003	N/A	Insufficient detects for UCL	N/A	<	3.00E-03	3.00E+00	Median	5.00E-03	5.00E+00	Max D
	Copper, dissolved	mg/L	33	27	6	18%	0.001	0.02	7.44E-03	0.001	0.11	8.24E-03	0.003	2.20E-02	95% KM (Chebyshev) UCL	Nonparametric		7.44E-03	7.44E+00	KM Mean	2.20E-02	2.20E+01	95% UCL
	Lead, dissolved	mg/L	34	7	27	79%	0.001	0.01	1.40E-03	0.001	0.004	3.12E-03	0.002	1.77E-03	95% KM (t) UCL	Normal	<	2.00E-03	2.00E+00	Median	4.00E-03	4.00E+00	Max D
	Nickel, dissolved	mg/L	39	17	22	56%	0.001	0.01	1.32E-03	0.001	0.005	1.54E-03	0.001	1.52E-03	95% KM (t) UCL	Nonparametric	<	1.00E-03	1.00E+00	Median	1.52E-03	1.52E+00	95% UCL
USGS 04024000	Selenium, dissolved	mg/L	73	3	70	96%	0.001	0.001	1.48E-03	0.001	0.02	1.48E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	2.00E-02	2.00E+01	Max D
	Silver, dissolved	mg/L	53	1	52	98%	0.001	0.002	1.00E-03	0.001	0.001	1.02E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	1.00E-03	1.00E+00	Max D
	Thallium, total	mg/L	0																				
	Zinc, dissolved	mg/L	55	45	10	18%	0.003	0.02	1.88E-02	0.005	0.11	2.02E-02	0.017	3.00E-02	95% KM (Chebyshev) UCL	Nonparametric		1.88E-02	1.88E+01	KM Mean	3.00E-02	3.00E+01	95% UCL
	Chloride	mg/L	387	386	1	0%	0.2	0.2	8.15E+00	0.1	32	8.15E+00	6.8	9.33E+00	95% KM (Chebyshev) UCL	Nonparametric		8.15E+00		KM Mean	9.33E+00		95% UCL
	Hardness, as CaCO3	mg/L	267	267	0	0%	N/A	N/A	7.67E+01	8	190	7.67E+01	73	7.88E+01	95% Student's-t UCL	Nonparametric		7.67E+01		Arith Mean	7.88E+01		95% UCL
	pH	S.U.	316	316	0	0%	N/A	N/A	7.37E+00	6.3	9.5	7.37E+00	7.4	7.42E+00	95% Student's-t UCL	Nonparametric		7.37E+00		Arith Mean	7.42E+00		95% UCL
	Solids, total dissolved	mg/L	249	249	0	0%	N/A	N/A	1.46E+02	52	257	1.46E+02	142	1.50E+02	95% Student's-t UCL	Normal		1.46E+02		Arith Mean	1.50E+02		95% UCL
	Specific Conductance @ 25	uS/cm	319	319	0	0%	N/A	N/A	1.83E+02	67	396	1.83E+02	175	1.88E+02	95% Approximate Gamma UCL	Gamma		1.83E+02		Arith Mean	1.88E+02		95% UCL
	Sulfate, as SO4	mg/L	268	268	0	0%	N/A	N/A	1.77E+01	2.45	39	1.81E+01	18	1.83E+01	95% Student's-t UCL	Nonparametric		1.81E+01		Arith Mean	1.83E+01		95% UCL
	Mercury, total	ng/L	4	4	0	0%	N/A	N/A	4.60E+00	1.1	9.4	4.60E+00	3.95	N/A	Insufficient detects for UCL	N/A		4.60E+00		Arith Mean	9.40E+00		Max D
USGS 04187500	Mercury, total	ng/L	3	3	0	0%	N/A	N/A	4.13E+00	1.5	8.9	4.13E+00	2	N/A	Insufficient detects for UCL	N/A		4.13E+00		Arith Mean	8.90E+00		Max D
SW004a	Mercury, total	ng/L	19	19	0	0%	N/A	N/A	3.82E+00	0.79	12.5	3.82E+00	2.98	5.05E+00	95% Student's-t UCL	Normal		3.82E+00		Arith Mean	5.05E+00		95% UCL
	Aluminum, total	mg/L	55	25	30	55%	0.0004	0.025	1.55E-02	0.0116	0.0637	2.30E-02	0.0233	2.00E-02	95% KM Approximate Gamma UCL	Gamma		2.33E-02	2.33E+01	Median	6.37E-02	6.37E+01	Max D
	Antimony, total	mg/L	11	0	11	[redacted]	0.0005	0.0005	N/A	N/A	N/A	5.00E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	5.00E-04	5.00E-01	Max ND
	Arsenic, total	mg/L	41	19	22	54%	0.00031	0.002	6.03E-04	0.00033	0.002	8.30E-04	0.00051	6.95E-04	95% H-UCL	Lognormal		5.10E-04	5.10E-01	Median	6.95E-04	6.95E-01	95% UCL
	Boron, total	mg/L	98	96	2	2%	0.1	0.1	2.11E-01	0.092	0.311	2.11E-01	0.229	2.21E-01	95% KM (t) UCL	Nonparametric		2.11E-01	2.11E+02	KM Mean	2.21E-01	2.21E+02	95% UCL
	Cadmium, total	mg/L	27	2	25	93%	0.0002	0.0002	7.35E-05	0.00005	0.000097	1.91E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.00E-04	2.00E-01	Max ND
	Chromium, total	mg/L	20	3	17	85%	0.001	0.001	1.05E-03	0.0011	0.0017	1.05E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	1.70E-03	1.70E+00	Max D
	Cobalt, total	mg/L	102	49	53	52%	0.0002	0.005	3.43E-04	0.00017	0.001	8.82E-04	0.00048	3.83E-04	95% KM (t) UCL	Nonparametric	<	4.80E-04	4.80E-01	Median	1.00E-03	1.00E+00	Max D
	Copper, total	mg/L	68	50	18	26%	0.0005	0.01	9.59E-04	0.00055	0.00202	1.42E-03	0.00094	1.04E-03	95% KM (t) UCL	Nonparametric		9.59E-04	9.59E-01	KM Mean	1.04E-03	1.04E+00	95% UCL
	Lead, total	mg/L	54	2	52	96%	0.00003	0.001	7.40E-05	0.000083	0.001	5.91E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	1.00E-03	1.00E+00	Max D
	Nickel, total	mg/L	60	36	24	40%	0	0.005	1.11E-03	0.00051	0.005	1.54E-03	0.001	2.81E-03	95% KM (Chebyshev) UCL	Nonparametric		1.11E-03	1.11E+00	KM Mean	2.81E-03	2.81E+00	95% UCL
SD026/PM7	Selenium, total	mg/L	31	3	28	90%	0.001	0.0036	1.82E-04	0.000037	0.002	1.50E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	2.00E-03	2.00E+00	Max D
	Silver, total	mg/L	17	1	16	94%	0.0002	0.001	2.47E-04	0.001	0.001	4.45E-04	0.00024	N/A	Insufficient detects for UCL	N/A	<	2.40E-04	2.40E-01	Median	1.00E-03	1.00E+00	Max D
	Thallium, total	mg/L	21	2	19	90%	0.000002	0.0002	2.17E-06	0.000002	0.000003	6.92E-05	0.000005	N/A	Insufficient detects for UCL	N/A	<	5.00E-06	5.00E-03	Median	2.00E-04	2.00E-01	Max ND
	Zinc, total	mg/L	68	25	43	63%	0.00024	0.025	6.52E-03	0.002	0.0825	1.08E-02	0.0075	1.68E-02	95% KM H-UCL	Lognormal		7.50E-03	7.50E+00	Median	1.68E-02	1.68E+01	95% UCL
	Chloride	mg/L	155	155	0	0%	N/A	N/A	1.15E+01	3.1	21.5	1.15E+01	11.2	1.20E+01	95% Student's-t UCL	Normal		1.15E+01		Arith Mean	1.20E+01		95% UCL
	Hardness, as CaCO3	mg/L	220	220	0	0%	N/A	N/A	4.66E+02	175	780	4.66E+02	469.5	4.79E+02	95% Student's-t UCL	Nonparametric		4.66E+02		Arith Mean	4.79E+02		95% UCL
	pH	S.U.	296	296	0	0%	N/A	N/A	7.82E+00	6.77	8.7	7.82E+00	7.89	7.85E+00	95% Student's-t UCL	Normal		7.82E+00		Arith Mean	7.85E+00		95% UCL
	Solids, total dissolved	mg/L	155	155	0	0%	N/A	N/A	6.50E+02	350	1540	6.50E+02	677	6.69E+02	95% Student's-t UCL	Nonparametric		6.50E+02		Arith Mean	6.69E+02		95% UCL
	Specific Conductance @ 25	uS/cm	299	299	0	0%	N/A	N/A	1.01E+03	1	1393	1.00E+03	1039	1.02E+03	95% Student's-t UCL	Nonparametric		1.00E+03		Arith Mean	1.02E+03		95% UCL
	Sulfate, as SO4	mg/L	154	153	1	1%	1	1	1.73E+02	97.4	360	1.74E+02	175	1.79E+02	95% KM (t) UCL	Normal		1.73E+02		KM Mean	1.79E+02		95% UCL
	Mercury, total	ng/L	89	47	42	47%	0.1	25	6.03E-01	0.18	2.1	1.56E+00	0.6	6.82E-01	95% KM Approximate Gamma UCL	Gamma		6.03E-01		KM Mean	6.82E-01		95% UCL
	Aluminum, total	mg/L	38	28	10	26%	0.02	0.04	2.36E-02	0.0102	0.0764	2.53E-02	0.0222	2.69E-02	95% KM (t) UCL	Normal		2.36E-02	2.36E+01	KM Mean	2.69E-02	2.69E+01	95% UCL
	Antimony, total	mg/L	17	0	17	[redacted]	0.0005	0.0005	N/A	N/A	N/A	5.00E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	5.00E-04	5.00E-01	Max ND
	Arsenic, total	mg/L	38	20	18	47%	0.00031	0.00082	9.03E-04	0.0005	0.0037	9.93E-04	0.000515	1.23E-03	95% KM Adjusted Gamma UCL	Gamma		9.03E-04	9.03E-01	KM Mean	1.23E-03	1.23E+00	95% UCL
	Boron, total	mg/L	12	11	1	8%	0.1	0.1	1.42E-01	0.114	0.185	1.42E-01	0.142	1.55E-01	95% KM (t) UCL	Normal		1.42E-01	1.42E+02	KM Mean	1.55E-01	1.55E+02	95% UCL
	Cadmium, total	mg/L	12	0	12	[redacted]	0.0002	0.0002	N/A	N/A	N/A	2.00E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.00E-04	2.00E-01	Max ND
	Chromium, total	mg/L	12	0	12	[redacted]	0.001	0.001	N/A	N/A	N/A	1.00E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	1.00E-03	1.00E+00	Max ND
	Cobalt, total	mg/L	38	18	20	53%	0.0002	0.0002	2.87E-04	0.0002	0.00072	2.87E-04	0.0002	3.29E-04	95% KM (t) UCL	Normal	<	2.00E-04	2.00E-01	Median	3.29E-04	3.29E-01	95% UCL

	Copper, total	mg/L	38	17	21	55%	0.0005	0.0005	6.57E-04	0.00051	0.0036	6.57E-04	0.0005	7.98E-04	95% KM (t) UCL	Nonparametric	<	5.00E-04	5.00E-01	Median	7.98E-04	7.98E-01	95% UCL
	Lead, total	mg/L	38	0	38	[illegible]	0.0005	0.0005	N/A	N/A	N/A	5.00E-04	0.0005	N/A	Insufficient detects for UCL	N/A	<	5.00E-04	5.00E-01	Median	5.00E-04	5.00E-01	Max ND
	Nickel, total	mg/L	38	10	28	74%	0.0005	0.001	5.59E-04	0.00052	0.0012	5.72E-04	0.0005	6.05E-04	95% KM (t) UCL	Nonparametric	<	5.00E-04	5.00E-01	Median	6.05E-04	6.05E-01	95% UCL
TC-1A	Selenium, total	mg/L	24	0	24	[illegible]	0.001	0.001	N/A	N/A	N/A	1.00E-03	0.001	N/A	Insufficient detects for UCL	N/A	<	1.00E-03	1.00E+00	Median	1.00E-03	1.00E+00	Max ND
	Silver, total	mg/L	5	0	5	[illegible]	0.0002	0.0002	N/A	N/A	N/A	2.00E-04	0.0002	N/A	Insufficient detects for UCL	N/A	<	2.00E-04	2.00E-01	Median	2.00E-04	2.00E-01	Max ND
	Thallium, total	mg/L	24	0	24	[illegible]	0.0000004	0.00002	N/A	N/A	N/A	5.61E-06	0.000005	N/A	Insufficient detects for UCL	N/A	<	5.00E-06	5.00E-03	Median	2.00E-05	2.00E-02	Max ND
	Zinc, total	mg/L	38	2	36	95%	0.006	0.006	6.16E-03	0.0066	0.0115	6.16E-03	0.006	N/A	Insufficient detects for UCL	N/A	<	6.00E-03	6.00E+00	Median	1.15E-02	1.15E+01	Max D
	Chloride	mg/L	38	38	0	0%	N/A	N/A	1.73E+01	6.6	33.5	1.73E+01	15.2	1.95E+01	95% Student's-t UCL	Nonparametric		1.73E+01		Arith Mean	1.95E+01		95% UCL
	Hardness, as CaCO3	mg/L	38	38	0	0%	N/A	N/A	3.31E+02	144	547	3.31E+02	289	3.66E+02	95% KM Adjusted Gamma UCL	Gamma		3.31E+02		Arith Mean	3.66E+02		95% UCL
	pH	S.U.	38	38	0	0%	N/A	N/A	7.37E+00	6.85	7.82	7.37E+00	7.41	7.44E+00	95% Student's-t UCL	Normal		7.37E+00		Arith Mean	7.44E+00		95% UCL
	Solids, total dissolved	mg/L	38	38	0	0%	N/A	N/A	4.74E+02	231	722	4.74E+02	433.5	5.11E+02	95% Student's-t UCL	Normal		4.74E+02		Arith Mean	5.11E+02		95% UCL
	Specific Conductance @ 25	uS/cm	38	38	0	0%	N/A	N/A	7.24E+02	345.6	1150	7.23E+02	676.3	7.95E+02	95% Adjusted Gamma UCL	Gamma		7.23E+02		Arith Mean	7.95E+02		95% UCL
	Sulfate, as SO4	mg/L	38	36	2	5%	2	2	5.14E+01	1	132	5.14E+01	55.5	6.22E+01	95% KM (t) UCL	Normal		5.14E+01		KM Mean	6.22E+01		95% UCL
	Mercury, total	ng/L	12	12	0	0%	N/A	N/A	2.13E+00	0.77	5.1	2.13E+00	1.97	2.81E+00	95% Student's-t UCL	Normal		2.13E+00		Arith Mean	2.81E+00		95% UCL

Summary of Baseline Water Quality and MeasurableChange Conclusions
2016 Draft Antidegradation Conclusions and ProUCL results

Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	SD026 Existing Average Water Quality (substitution method)[3]		SD026 ProUCL Existing Water Quality Central Tendency[4]	SD026 LSC and UCL Measurable Increase Conclusion Same?	Trimble Creek Wetlands Existing Average Water Quality (substitution method)[3]		Trimble Creek Wetlands ProUCL Existing Water Quality Central Tendency[4]	Trimble Creek Wetlands LSC and UCL Measurable Increase Conclusion Same?	Unnamed Creek Wetlands Existing Average Water Quality (substitution method)[3]		Unnamed Creek Wetlands ProUCL Existing Water Quality Central Tendency[4]	Unnamed Creek Wetlands LSC and UCL Measurable Increase Conclusion Same?	TC-1a Existing Average Water Quality (substitution method)[3]		TC-1a ProUCL Existing Water Quality Central Tendency[4]	TC-1a LSC and UCL Measurable Increase Conclusion Same?	Parameter
Aluminum (total)	Al	µg/L	125	2	18.4		23.3	Yes	22.4		23.6	Yes	17		29.9	Yes	22.4		23.6	No	Al
Antimony (total)	Sb	µg/L	31	0.53	0.86	<	0.5	Yes	n.d.	<	0.5	Yes	n.d.	<	0.5	Yes	n.d.	<	0.50	Yes	Sb
Arsenic (total)	As	µg/L	53	0.5	0.62		0.51	Yes	0.87		0.90253	Yes	0.87		0.92	Yes	0.87		0.90	Yes	As
Boron (total)	B	µg/L	500	100	210		211	No - UCL indicates measurable change	138		142	Yes	207		210	Yes	138		142	No - UCL indicates measurable change	B
Cadmium (total)	Cd	µg/L	2.5[7]	0.2	n.d.	<	0.2	Yes	n.d.	<	0.2	Yes	n.d	<	0.2	Yes	n.d.	<	0.2	Yes	Cd
Chromium (total)	Cr	µg/L	11[7]	1	n.d.	<	1	Yes	n.d.	<	1	Yes	n.d	<	1	Yes	n.d.	<	1	Yes	Cr
Cobalt (total)	Co	µg/L	5	0.2	0.54	<	0.48	No- change not measurable using UCL	0.23	<	0.2	Yes	0.3	<	0.2	Yes	0.23	<	0.2	Yes	Co
Copper (total)	Cu	µg/L	9.3[7]	0.5	1.11		0.96	Yes	0.52	<	0.5	Yes	0.93		0.84	Yes	0.52	<	0.5	Yes	Cu
Lead (total)	Pb	µg/L	3.2[7]	0.5	n.d.	<	0.5	Yes	n.d.	<	0.5	Yes	n.d	<	0.5	Yes	n.d.	<	0.5	Yes	Pb
Nickel (total)	Ni	µg/L	52[7]	0.5	1.32		1.11	Yes	n.d.	<	0.5	Yes	0.68		0.57	Yes	n.d.	<	0.5	Yes	Ni
Selenium (total)	Se	µg/L	5	1	n.d.	<	1	No- change not measurable using UCL	n.d.	<	1	Yes	n.d	<	1	No- change not measurable using UCL	n.d.	<	1	Yes	Se
Silver (total)	Ag	µg/L	1	0.2	0.25	<	0.24	Yes	n.d.	<	0.2	Yes	n.d.	<	0.2	No- change not measurable using UCL	n.d.	<	0.2	Yes	Ag
Thallium	Tl	µg/L	0.56	0.005	0.26	<	0.005	Yes	n.d.	<	0.005	Yes	0.12		0.0075	Yes	n.d.	<	0.005	Yes	Tl
Zinc (total)	Zn	µg/L	120[7]	6	8.2		7.5	Yes	n.d.	<	6	Yes	n.d	<	6	Yes	n.d.	<	6	Yes	Zn
Chloride	Cl	mg/L	230	5	11.5		11.5	Yes	17.3		17.3	Yes	17		17.0	Yes	17.3		17.3	Yes	Cl
Hardness (as $CaCO_3$)		mg/L	500	10	439		466	Yes	331		331	Yes	373		373	Yes	331		331	Yes	hardness
pH		SU	6.5 to 8.5	0.01	7.8		7.8	Yes	7.4		7.4	Yes	7.6		7.6	Yes	7.4		7.37	Yes	pH
Solids, total dissolved[9]		mg/L	700	10	650		650	Yes	474		474	Yes	492		492	Yes	474		474	Yes	TDS
Specific Conductance @ 25°C[10]		µS/cm	1,000	0	997		1005	Yes	723		723	Yes	793		793	Yes	723		723	Yes	Sp. Cond.
Sulfate	SO_4	mg/L	none[8]	1	173		173	Yes	51.4		51.4	Yes	114		115	Yes	51.4		51	Yes	SO_4

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.

(4) Central Tendency determined as described in Table 1.

(5) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit, and adjusted for flows from the LTVSMC pits that began after ther monitoring data w

(6) Central Tendency determined as described in Table 1, adjusted for flows from the LTVSMC pits that began after ther monitoring data was collected.

Summary of Baseline Water Quality and MeasurableChange Conclusions
2016 Draft Antidegradation Conclusions and ProUCL results

PM-11			PM-13			MNSW8			MNSW12			Scanlon		
Existing Average Water Quality (substitution method)[3]	ProUCL Existing Water Quality Central Tendency[4]	LSC and UCL Measurable Increase Conclusion Same?	Existing Average Water Quality (substitution method)[3]	ProUCL Existing Water Quality Central Tendency[4]	LSC and UCL Measurable Increase Conclusion Same?	Existing Average Water Quality (substitution method)[5]	ProUCL Existing Water Quality Central Tendency[6]	LSC and UCL Measurable Increase Conclusion Same?	Existing Average Water Quality (substitution method)[5]	ProUCL Existing Water Quality Central Tendency[6]	LSC and UCL Measurable Increase Conclusion Same?	Existing Average Water Quality (substitution method)[5]	ProUCL Existing Water Quality Central Tendency[6]	LSC and UCL Measurable Increase Conclusion Same?
29.5	29.9	Yes	187	180.84	No	35.9	35.9	Yes	96.5	96.7	Yes	100	101	Yes
n.d.	< 0.5	Yes	n.d.	< 0.50	Yes	n.d.	0.10	Yes	n.d.	0.1		Not Available	Not Available	Yes
0.87	0.92	Yes	1.1	1.1	Yes	1.42	1.50	Yes	1.04	1.02	Yes	1.47	1.64	Yes
207	210	Yes	n.d	59.5	Yes	107	107	Yes	108	104	Yes	112	112	Yes
n.d.	< 0.2	Yes	n.d	< 0.2	Yes	n.d.	< 0.14	Yes	n.d.	< 0.19	Yes	1.36	< 1.00	Yes
n.d.	< 1	Yes	n.d	< 1	No- change not measurable using UCL	n.d.	0.71	Yes	n.d.	0.61	Yes	6.4	6.2	Yes
0.3	< 0.2	Yes	0.44	0.41	Yes	0.73	0.73	Yes	0.5	0.48	Yes	1.49	< 2.99	Yes
0.93	0.84	Yes	1.32	1.2	Yes	1.18	1.23	No- change not measurable using UCL	3.17	3.2	Yes	7.5	7.4	Yes
n.d.	< 0.5	Yes	n.d	< 0.5	Yes	n.d.	0.24	Yes	n.d.	0.27	Yes	1.77	< 1.99	Yes
0.68	0.57	Yes	1.46	1.4	Yes	4.12	4.09	Yes	3.64	3.51	Yes	1.15	< 1.01	Yes
n.d.	< 1	No- change not measurable using UCL	n.d.	< 1	Yes	n.d.	0.97	Yes	n.d.	0.6	Yes	1.0	< 1.0	Yes
n.d.	< 0.2	Yes	n.d.	< 0.22	Yes	n.d.	0.06	Yes	n.d.	0.0	Yes	0.52	< 1.00	Yes
0.0075	0.0075	No - UCL indicates measurable change	0.135	< 0.005	No - UCL indicates measurable change	0.2	< 0.31	Yes	0.2	< 0.4	No - UCL indicates measurable change	Not Available	Not Available	Yes
n.d.	< 6	Yes	7.0	< 6	Yes	n.d.	4.86	Yes	n.d.	4.3	Yes	18.8	18.7	Yes
17	17.0	Yes	7.3	7.0	Yes	16.5	16.5	Yes	7.1	6.6	Yes	8.2	8.2	Yes
373	373	Yes	139	139	Yes	806	785	Yes	356	331	Yes	80	80	Yes
7.6	7.6	Yes	7.4	7.4	Yes	7.99	7.99	Yes	7.66	7.7	No	7.4	7.4	Yes
492	492	Yes	227	227	Yes	967	970	Yes	452	428	No	150	150	Yes
793	793	Yes	284	284	Yes	1336	1336	Yes	700	840	No	189	188	Yes
115	115	Yes	53	51	Yes	472	471	Yes	202	190	Yes	19.7	20.1	Yes

as collected. (See Attachment E of the Antidegradation Evaluation for details)

Second Creek Headwaters Segment (SD026) (Receiving Water)
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
Antidegradation Results and ProUCL Results

							2016 Draft Antidegradation			ProUCL (Non-substitution methods)			
Parameter	Units	Applicable Standard(1)	Typical Reporting Limit (PQL)(2)	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 (3)	Existing Average Water Quality (substitution method)(4)	Upper LCS Limit(5)	Measurable Increase by LCS method?(6)	Existing Water Quality Central Tendency(7)	95th Percentile UCL(8)	Measurable Increase by UCL Method? (9)	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total) Al	µg/L	125	2	55	55%	6.3	18.4	21.2	No	23.3	63.7	No	Yes
Antimony (total) Sb	µg/L	31	0.53	11	100%	6.3	0.86	1	Yes	< 0.5	0.5	Yes	Yes
Arsenic (total) As	µg/L	53	0.5	41	54%	10	0.62	0.70	Yes	0.51	0.69	Yes	Yes
Boron (total) B	µg/L	500	100	98	2%	230	210	242	No	211	211	Yes	No
Cadmium (total) Cd	µg/L	2.5(10)	0.2	27	93%	0.71	n.d.	N/A	Yes	< 0.2	0.2	Yes	Yes
Chromium (total) Cr	µg/L	11(10)	1	20	85%	5.3	n.d.	N/A	Yes	< 1	1.7	Yes	Yes
Cobalt (total) Co	µg/L	5	0.2	102	52%	5	0.54	0.62	Yes	< 0.48	1	Yes	No
Copper (total) Cu	µg/L	9.3(10)	0.5	68	26%	9	1.11	1.3	Yes	0.96	1.04	Yes	Yes
Lead (total) Pb	µg/L	3.2(10)	0.5	54	96%	3	n.d.	N/A	Yes	< 0.5	1	Yes	Yes
Nickel (total) Ni	µg/L	52(10)	0.5	60	40%	50	1.32	1.5	Yes	1.11	2.81	Yes	Yes
Selenium (total) Se	µg/L	5	1	31	90%	1.6	n.d.	N/A	Yes	< 1	2	No	No
Silver (total) Ag	µg/L	1	0.2	17	94%	0.21	0.25	0.29	No	< 0.24	1	No	Yes
Thallium (total) Tl	µg/L	0.56	0.005	21	90%	0.16	0.26	0.3	No	< 0.005	0.2	No	Yes
Zinc (total) Zn	µg/L	120(10)	6	68	63%	57.1	8.2	9.4	Yes	7.5	16.8	Yes	Yes
Chloride Cl	mg/L	230	5	155	0%	23.4	11.5	12.5	Yes	11.5	12	Yes	Yes
Hardness (as $CaCO_3$)	mg/L	500	10	220	0%	100	439	505	No	466	479	No	Yes
pH	SU	6.5 to 8.5	0.01	296	0%	8.4	7.83	8.0	Yes	7.8	7.9	Yes	Yes
Solids, total dissolved(12)	mg/L	700	10	155	0%	464	650	780	No	650	669	No	Yes
Specific Conductance @ 25°C(13)	µS/cm	1,000	0	299	0%	960	997	1007	No	1005	1020	No	Yes
Sulfate SO_4	mg/L	none(11)	1	154	1%	10	173	189.2	No	173	179	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Anticipated water quality at the outfalls is equal to the antidegradation discharge quality (see Section 5.7 of Antidegradation Evaluation). No mixing is assumed.

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation Evaluation

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.

(7) Central Tendency determined as described in Table 1.

(8) 95% UCL determined as described in Table 2.

(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The proposed receiving waters are not listed wild rice waters, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used

Trimble Creek Headwaters Wetlands (Receiving Water)
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

								2016 Draft Antidegradation			ProUCL (Non-substitution methods)			
Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 [3]	Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Existing Water Quality Central Tendency[7]	95th Percentile UCL[8]	Measurable Increase by UCL Method? [9]	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total)	Al	µg/L	125	2	38	26%	6.3	22.4	25.8	No	23.6	26.9	No	Yes
Antimony (total)	Sb	µg/L	31	0.53	17	100%	6.3	n.d.	N/A	Yes	< 0.5	0.5	Yes	Yes
Arsenic (total)	As	µg/L	53	0.5	38	47%	10	0.87	1	Yes	0.90253	1.23	Yes	Yes
Boron (total)	B	µg/L	None	100	12	8%	230	138	159	Yes	142	155	Yes	Yes
Cadmium (total)	Cd	µg/L	2.5[10]	0.2	12	100%	0.71	n.d.	N/A	Yes	< 0.2	0.2	Yes	Yes
Chromium (total)	Cr	µg/L	11[10]	1	12	100%	5.3	n.d.	N/A	Yes	< 1	1	Yes	Yes
Cobalt (total)	Co	µg/L	5	0.2	38	53%	5	0.23	0.26	Yes	< 0.2	0.33	Yes	Yes
Copper (total)	Cu	µg/L	9.3[10]	0.5	38	55%	9	0.52	0.6	Yes	< 0.5	0.80	Yes	Yes
Lead (total)	Pb	µg/L	3.2[10]	0.5	38	100%	3	n.d.	N/A	Yes	< 0.5	0.5	Yes	Yes
Nickel (total)	Ni	µg/L	52[10]	0.5	38	74%	50	n.d.	N/A	Yes	< 0.5	0.61	Yes	Yes
Selenium (total)	Se	µg/L	5	1	24	100%	1.6	n.d.	N/A	Yes	< 1	1	Yes	Yes
Silver (total)	Ag	µg/L	1	0.2	5	100%	0.21	n.d.	N/A	Yes	< 0.2	0.2	Yes	Yes
Thallium (total)	Tl	µg/L	0.56	0.005	24	100%	0.16	n.d.	N/A	Yes	< 0.005	0.02	Yes	Yes
Zinc (total)	Zn	µg/L	120[10]	6	38	95%	57.1	n.d.	N/A	Yes	< 6	11.5	Yes	Yes
Chloride	Cl	mg/L	230	5	38	0%	23.4	17.3	19	Yes	17.3	19.5	Yes	Yes
Hardness (as $CaCO_3$)		mg/L	Maintain Background [11]	10	38	0%	100	331	381	No	331	366	No	Yes
pH		SU	Maintain Background [11]	0.01	38	0%	8.4	7.4	7.6	Yes	7.4	7.4	Yes	Yes
Solids, total dissolved[13]		mg/L	None	10	38	0%	464	474	569	No	474	511	No	Yes
Specific Conductance @ 25°C[14]		µS/cm	None	0	38	0%	960	723	730	Yes	723	795	Yes	Yes
Sulfate	SO_4	mg/L	none[12]	1	38	5%	10	51.4	57	No	51	62	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.
N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Anticipated water quality at the outfalls is equal to the antidegradation discharge quality (see Section 5.7 of Antidegradation Evaluation). No mixing is assumed.

(4) Existing conditions estimated based on stream monitoring data from TC-1a as discussed in Section 5.5 of the Antidegradation Evaluation. Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation Evaluation

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.

(7) Central Tendency determined as described in Table 1.

(8) 95% UCL determined as described in Table 2.

(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) Maintain background "means the concentration of the water quality substances, characteristics, or pollutants shall not deviate from the range of natural background concentrations or conditions such that there is a potential significant adverse impact to the designated uses." (Minnesota Rules, part 7050.0222, subpart 6(B) and part 7050.0223, subpart 5

(12) The proposed receiving waters are not listed wild rice waters, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(13) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(14) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

Unnamed Creek Headwaters Wetlands
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters (Receiving Water)
2016 Draft Antidegradation Conclusions and ProUCL results

							2016 Draft Antidegradation			ProUCL (Non-substitution methods)			
Parameter	Units	Applicable Standard(1)	Typical Reporting Limit (PQL)(2)	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 (3)	Existing Average Water Quality (substitution method)(4)	Upper LCS Limit(5)	Measurable Increase by LCS method?(6)	Existing Water Quality Central Tendency(7)	95th Percentile UCL(8)	Measurable Increase by UCL Method? (9)	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total) Al	µg/L	125	2	66	27%	6.3	29.5	N/A	No	29.9	34	No	Yes
Antimony (total) Sb	µg/L	31	0.53	35	100%	6.3	n.d.	N/A	Yes	< 0.5	3	Yes	Yes
Arsenic (total) As	µg/L	53	0.5	58	40%	10	0.87	1	Yes	0.92	1.03	Yes	Yes
Boron (total) B	µg/L	None	100	23	4%	230	207	238	No	210	232	No	Yes
Cadmium (total) Cd	µg/L	2.5(10)	0.2	26	81%	0.71	n.d	N/A	Yes	< 0.2	0.2	Yes	Yes
Chromium (total) Cr	µg/L	11(10)	1	26	81%	5.3	n.d	N/A	Yes	< 1	2.3	Yes	Yes
Cobalt (total) Co	µg/L	5	0.2	64	73%	5	0.3	0.35	Yes	< 0.2	0.83	Yes	Yes
Copper (total) Cu	µg/L	9.3(10)	0.5	66	20%	9	0.93	1.07	Yes	0.84	0.92	Yes	Yes
Lead (total) Pb	µg/L	3.2(10)	0.5	60	90%	3	n.d	N/A	Yes	< 0.5	1.00	Yes	Yes
Nickel (total) Ni	µg/L	52(10)	0.5	66	62%	50	0.68	0.78	Yes	0.57	0.74	Yes	Yes
Selenium (total) Se	µg/L	5	1	42	93%	1.6	n.d	N/A	yes	< 1	3.6	No	No
Silver (total) Ag	µg/L	1	0.2	21	100%	0.21	n.d.	N/A	Yes	< 0.2	1	No	No
Thallium (total) Tl	µg/L	0.56	0.005	47	89%	0.16	0.12	0.14	Yes	0.0075	0.0092	Yes	Yes
Zinc (total) Zn	µg/L	120(10)	6	66	89%	57.1	n.d	N/A	yes	< 6	41.2	Yes	Yes
Chloride Cl	mg/L	230	5	81	0%	23.4	17	18.7	Yes	17.0	18.6	Yes	Yes
Hardness (as $CaCO_3$)	mg/L	Maintain Background(11)	10	66	0%	100	373	429	No	373	407	No	Yes
pH	SU	Maintain Background (11)	0.01	76	0%	8.4	7.6	7.8	Yes	7.6	7.6	Yes	Yes
Solids, total dissolved(13)	mg/L	None	10	66	0%	464	492	590	No	492	532	No	Yes
Specific Conductance @ 25°C(14)	µS/cm	None	0	70	0%	960	793	801	Yes	793	849	Yes	Yes
Sulfate SO_4	mg/L	none(12)	1	85	0%	10	114	125	No	115	146	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.
N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.
(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052
(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).
(3) Anticipated water quality at the outfalls is equal to the antidegradation discharge quality (see Section 5.7 of Antidegradation Evaluation). No mixing is assumed.
(4) Existing conditions estimated based on stream monitoring data from TC-1a as discussed in Section 5.5 of the Antidegradation Evaluation. Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.
(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation Evaluation
(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.
(7) Central Tendency determined as described in Table 1.
(8) 95% UCL determined as described in Table 2.
(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.
(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.
(11) Maintain background "means the concentration of the water quality substances, characteristics, or pollutants shall not deviate from the range of natural background concentrations or conditions such that there is a potential significant adverse impact to the designated uses." (Minnesota Rules, part 7050.0222, subpart 6(B) and part 7050.0223, subpart 5)
(12) The proposed receiving waters are not listed wild rice waters, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.
(13) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.
(14) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

Trimble Creek at TC-1a (Embarras River Watershed)
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

							2016 Draft Antidegradation			ProUCL (Non-substitution methods)			
Parameter	Units	Applicable Standard(1)	Typical Reporting Limit (PQL)(2)	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 (3)	Existing Average Water Quality (substitution method)(4)	Upper LCS Limit(5)	Measurable Increase by LCS method?(6)	Existing Water Quality Central Tendency(7)	95th Percentile UCL(8)	Measurable Increase by UCL Method? (9)	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total) Al	µg/L	125	2	38	26%	19.6	22.4	--(14)	No	23.6	26.9	No	Yes
Antimony (total) Sb	µg/L	31	0.53	17	100%	5.2	n.d.	N/A	Yes	< 0.5	0.5	Yes	Yes
Arsenic (total) As	µg/L	53	0.5	38	47%	8.9	0.87	1	Yes	0.90	1.2	Yes	Yes
Boron (total) B	µg/L	500	100	12	8%	159	138	159	No	142	155	Yes	No
Cadmium (total) Cd	µg/L	2.5(10)	0.2	12	100%	0.6	n.d.	N/A	Yes	< 0.2	0.2	Yes	Yes
Chromium (total) Cr	µg/L	11(10)	1	12	100%	4.5	n.d.	N/A	Yes	< 1	1	Yes	Yes
Cobalt (total) Co	µg/L	5	0.2	38	53%	4.5	0.23	0.26	Yes	< 0.2	0.33	Yes	Yes
Copper (total) Cu	µg/L	9.3(10)	0.5	38	55%	7.9	0.52	0.6	Yes	< 0.5	0.80	Yes	Yes
Lead (total) Pb	µg/L	3.2(10)	0.5	38	100%	2.6	n.d.	N/A	Yes	< 0.5	0.5	Yes	Yes
Nickel (total) Ni	µg/L	52(10)	0.5	38	74%	43.1	n.d.	N/A	Yes	< 0.5	0.61	Yes	Yes
Selenium (total) Se	µg/L	5	1	24	100%	1.4	n.d.	N/A	Yes	< 1	1	Yes	Yes
Silver (total) Ag	µg/L	1	0.2	5	100%	0.2	n.d.	N/A	No	< 0.2	0.2	No	Yes
Thallium (total) Tl	µg/L	0.56	0.005	24	100%	0.14	n.d.	N/A	Yes	< 0.005	0.02	Yes	Yes
Zinc (total) Zn	µg/L	120(10)	6	38	95%	48.3	n.d.	N/A	Yes	< 6	11.5	Yes	Yes
Chloride Cl	mg/L	230	5	38	0%	Not Available	17.3	19	N/A	17.3	19.5	N/A	Yes
Hardness (as $CaCO_3$)	mg/L	500	10	38	0%	114	331	381	No	331	366	No	Yes
pH	SU	6.5 to 8.5	0.01	38	0%	Not Available	7.4	7.6	N/A	7.37	7.44	N/A	Yes
Solids, total dissolved(12)	mg/L	700	10	38	0%	145	474	569	No	474	511	No	Yes
Specific Conductance @ 25°C(13)	µS/cm	1,000	0	38	0%	181	723	730	No	723	795	No	Yes
Sulfate SO_4	mg/L	none(11)	1	38	5%	8.3	51.4	56.5	No	51	62	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Estimated future water quality is from the FEIS GoldSim water modeling results.

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation Evaluation

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.

(7) Central Tendency determined as described in Table 1.

(8) 95% UCL determined as described in Table 2.

(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

(14) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

Unnamed Creek at PM-11 (Embarras River Watershed)
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 [3]	2016 Draft Antidegradation			ProUCL (Non-substitution methods)			LSC and UCL Measurable Increase Conclusion Same?
								Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Existing Water Quality Central Tendency[7]	95th Percentile UCL[8]	Measurable Increase by UCL Method? [9]	
Aluminum (total)	Al	µg/L	125	2	66	27%	39.2	29.5	N/A	--[14]	29.9	34	--[14]	Yes
Antimony (total)	Sb	µg/L	31	0.53	35	100%	3.9	n.d.	N/A	Yes	< 0.5	3	Yes	Yes
Arsenic (total)	As	µg/L	53	0.5	58	40%	7	0.87	1	Yes	0.92	1.03	Yes	Yes
Boron (total)	B	µg/L	500	100	23	4%	124	207	238	No	210	232	No	Yes
Cadmium (total)	Cd	µg/L	2.5[10]	0.2	26	81%	0.46	n.d.	N/A	Yes	< 0.2	0.2	Yes	Yes
Chromium (total)	Cr	µg/L	11[10]	1	26	81%	3.5	n.d.	N/A	Yes	< 1	2.3	Yes	Yes
Cobalt (total)	Co	µg/L	5	0.2	64	73%	3.7	0.3	0.35	Yes	< 0.2	0.83	Yes	Yes
Copper (total)	Cu	µg/L	9.3[10]	0.5	66	20%	6	0.93	1.07	Yes	0.84	0.92	Yes	Yes
Lead (total)	Pb	µg/L	3.2[10]	0.5	60	90%	2	n.d.	N/A	Yes	< 0.5	1.00	Yes	Yes
Nickel (total)	Ni	µg/L	52[10]	0.5	66	62%	31.9	0.68	0.78	Yes	0.57	0.74	Yes	Yes
Selenium (total)	Se	µg/L	5	1	42	93%	1.2	n.d.	N/A	Yes	< 1	3.6	No	No
Silver (total)	Ag	µg/L	1	0.2	21	100%	0.2	n.d.	N/A	No	< 0.2	1	No	Yes
Thallium (total)	Tl	µg/L	0.56	0.005	47	89%	0.11	0.12	0.14	No	0.0075	0.0092	Yes	No
Zinc (total)	Zn	µg/L	120[10]	6	66	89%	37.1	n.d.	N/A	Yes	< 6	41.2	No	No
Chloride	Cl	mg/L	230	5	81	0%	Not Available	17	18.7	N/A	17.0	18.6	N/A	Yes
Hardness (as $CaCO_3$)		mg/L	500	10	66	0%	85.4	373	429	No	373	407	No	Yes
pH		SU	6.5 to 8.5	0.01	76	0%	Not Available	7.6	7.8	N/A	7.6	7.6	N/A	Yes
Solids, total dissolved[12]		mg/L	700	10	66	0%	204	492	590	No	492	532	No	Yes
Specific Conductance @ 25°C[13]		µS/cm	1,000	0	70	0%	304	793	801	No	793	849	No	Yes
Sulfate	SO_4	mg/L	none[11]	1	85	0%	7	115	125	No	115	146	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Estimated future water quality is from the FEIS GoldSim water modeling results.

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation Evaluation

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.

(7) Central Tendency determined as described in Table 1.

(8) 95% UCL determined as described in Table 2.

(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

(14) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

Embarras River at PM-13 (Embarras River Watershed)
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

							2016 Draft Antidegradation			ProUCL (Non-substitution methods)			
Parameter	Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 [3]	Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Existing Water Quality Central Tendency[7]	95th Percentile UCL[8]	Measurable Increase by UCL Method? [9]	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total) Al	µg/L	125	2	64	0%	72.5	187	--[14]	No	181	252	No	Yes
Antimony (total) Sb	µg/L	31	0.53	26	100%	1.3	n.d.	N/A	Yes	< 0.5	3	No	No
Arsenic (total) As	µg/L	53	0.5	47	26%	2.9	1.1	1.27	Yes	1.1	1.27	Yes	Yes
Boron (total) B	µg/L	500 / None[9]	100	18	83%	61.2	n.d	N/A	No	59.5	68.9	No	Yes
Cadmium (total) Cd	µg/L	2.5[10]	0.2	21	90%	0.2	n.d	N/A	No	< 0.2	0.26	No	Yes
Chromium (total) Cr	µg/L	11[10]	1	21	76%	1.5	n.d	N/A	Yes	< 1	4.3	No	No
Cobalt (total) Co	µg/L	5	0.2	68	38%	1.8	0.44	0.51	Yes	0.41	0.45	Yes	Yes
Copper (total) Cu	µg/L	9.3[10]	0.5	70	6%	2.5	1.32	1.52	Yes	1.2	1.3	Yes	Yes
Lead (total) Pb	µg/L	3.2[10]	0.5	54	94%	0.76	n.d	N/A	Yes	< 0.5	0.63	Yes	Yes
Nickel (total) Ni	µg/L	52[10]	0.5	70	14%	10.2	1.46	1.7	Yes	1.4	1.5	Yes	Yes
Selenium (total) Se	µg/L	5	1	38	100%	0.74	n.d.	N/A	No	< 1	3.6	No	Yes
Silver (total) Ag	µg/L	1	0.2	16	100%	0.13	n.d.	N/A	No	< 0.22	1	No	Yes
Thallium (total) Tl	µg/L	0.56	0.005	38	79%	0.06	0.135	0.16	No	< 0.005	0.0051	Yes	No
Zinc (total) Zn	µg/L	120[10]	6	98	89%	15.9	7.0	8	Yes	< 6	61.0	No	No
Chloride Cl	mg/L	230	5	83	0%	Not Available	7.3	8	N/A	7.0	11.9	N/A	Yes
Hardness (as $CaCO_3$)	mg/L	500 / Maintain Background[9] [11]	10	68	0%	76.1	139	160	No	139	156	No	Yes
pH	SU	6.5 to 8.5 / Maintain Background[9] [11]	0.01	71	0%	Not Available	7.4	7.62	N/A	7.4	7.5	N/A	Yes
Solids, total dissolved[12]	mg/L	700 / None[9]	10	68	0%	166	227	272	No	227	248	No	Yes
Specific Conductance @ 25°C[13]	µS/cm	1,000 / None[9]	0	71	0%	208	284	287	No	284	317	No	Yes
Sulfate SO_4	mg/L	none[11]	1	87	0%	47.7	53	59	No	51	88.5	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.
N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.
(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).
(3) Estimated future water quality is from the FEIS GoldSim water modeling results.
(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit.
(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value.
(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.
(7) Central Tendency determined as described in Table 1.
(8) 95% UCL determined as described in Table 2.
(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.
(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.
(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.
(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation
(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical
(14) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

Second Creek at MNSW8
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

						2016 Draft Antidegradation				ProUCL (Non-substitution methods)								
Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	2016 Draft Estimated Future Water Quality[3]	Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Alternative Estimated Future Water Quality[7]	Existing Water Quality Central Tendency[8]	95th Percentile UCL[9]	Estimated Change in Existing Central Tendency due to LTVSMC Pits[14]	Estimated Adjusted Central Tendency[15]	Estimated Adjusted 95th Percentile UCL[16]	Measurable Increase by UCL Method?[17]	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total)	Al	µg/L	125	2	12	0%	35.6	35.9	--[18]	No	35.6	60	113	-23.8	35.9	89.2	No	Yes
Antimony (total)	Sb	µg/L	31	0.53	8	13%	0.29	n.d.	N/A	No	0.28	0.064	0.080	+0.03	0.10	0.11	No	Yes
Arsenic (total)	As	µg/L	53	0.5	12	42%	1.61	1.42	1.63	No	1.69	1.64	1.97	-0.14	1.50	1.83	No	Yes
Boron (total)	B	µg/L	500	100	8	0%	105	107	123	No	105	85	99.5	+21.8	107	121	No	Yes
Cadmium (total)	Cd	µg/L	2.5[10]	0.2	8	75%	0.1	n.d.	N/A	No	0.16	< 0.2	0.2	-0.06	0.14	0.14	No	Yes
Chromium (total)	Cr	µg/L	11[10]	1	8	25%	0.85	n.d.	N/A	No	0.88	0.57	0.79	+0.13	0.71	0.92	No	Yes
Cobalt (total)	Co	µg/L	5	0.2	8	0%	0.84	0.73	0.84	No	0.84	0.77	0.88	-0.05	0.73	0.84	No	Yes
Copper (total)	Cu	µg/L	9.3[10]	0.5	8	25%	1.4	1.18	1.36	Yes	1.40	0.78	0.95	+0.45	1.23	1.40	Yes	No
Lead (total)	Pb	µg/L	3.2[10]	0.5	8	38%	0.33	n.d.	N/A	No	0.36	0.23	0.94	+0.01	0.24	0.95	No	Yes
Nickel (total)	Ni	µg/L	52[10]	0.5	8	0%	5.54	4.12	4.74	Yes	5.51	5.73	6.73	-1.63	4.09	5.10	Yes	Yes
Selenium (total)	Se	µg/L	5	1	8	13%	1	n.d.	N/A	No	1.02	0.77	0.96	+0.20	0.97	1.16	No	Yes
Silver (total)	Ag	µg/L	1	0.2	8	38%	0.08	n.d.	N/A	No	0.06	0.0083	0.012	+0.05	0.06	0.06	No	Yes
Thallium (total)	Tl	µg/L	0.56	0.005	8	100%	0.2	0.2	0.23	No	0.30	< 0.4	0.4	-0.09	0.31	0.31	No	Yes
Zinc (total)	Zn	µg/L	120[10]	6	16	6%	6.6	n.d.	N/A	Yes	6.36	4.2	5.08	+0.66	4.86	5.74	Yes	Yes
Chloride	Cl	mg/L	230	5	23	0%	15.9	16.5	18.3	No	15.9	8.45	8.76	+8.04	16.5	16.8	No	Yes
Hardness (as $CaCO_3$)		mg/L	500	10	12	0%	795	806	927	No	774	806	887	-20.6	785	866	No	Yes
pH		SU	6.5 to 8.5	0.01	13	0%	Not Available	7.99	N/A	Not Available	Not Available	7.75	7.84	+0.23	7.99	8.07	Not Available	Yes
Solids, total dissolved[12]		mg/L	700	10	12	0%	Not Available	967	N/A	Not Available	Not Available	949	1058	+21.6	970	1080	Not Available	Yes
Specific Conductance @ 25°C[13]		µS/cm	1,000	0	13	0%	Not Available	1336	N/A	Not Available	Not Available	1323	1442	+12.1	1336	1454	Not Available	Yes
Sulfate	SO_4	mg/L	none[11]	1	12	0%	464	472	519	No	464	473	529	-1.09	471	528	No	Yes

n.d. -- All measured values are below reporting limits or the average value is below the reporting limit.

N/A -- The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Estimated future water quality estimated with mass balance calculations

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit, and adjusted for flows from the LTVSMC pits that began after ther monitoring data was collected. (See Attachment E of the Antidegradation Evaluation for details)

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6 of the Antidegradation Evaluation.

(7) Alternative future water quality estimated with mass balance calculations based on central tendency in column N

(8) Central Tendency determined as described in Table 1.

(9) 95% UCL determined as described in Table 2.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

(14) Changes to load and flow from LTVSMC pits estimated from water quality data as described in Attachment C.

(15) Existing water quality central tendency plus the change due to LTVSMC pits.

(16) 95th percentile UCL plus the change due to LTVSMC pits.

(17) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(18) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

Partridge River at MNSW12

Existing and Estimated Mine Year 10 Water Quality in Receiving Waters

2016 Draft Antidegradation Conclusions and ProUCL results

							2016 Draft Antidegradation				ProUCL (Non-substitution methods)								
Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	2016 Draft Estimated Future Water Quality [3]	Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Alternative Estimated Future Water Quality [7]	Existing Water Quality Central Tendency[8]		95th Percentile UCL[9]	Estimated Change in Existing Central Tendency due to LTVSMC Pits [14]	Estimated Adjusted Central Tendency [15]	Estimated Adjusted 95th Percentile UCL [16]	Measurable Increase by UCL Method?[17]	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total)	Al	μg/L	125	2	10	0%	96.3	96.5	--[18]	No	96.4		105	136	-8.07	96.7	127.9	No	Yes
Antimony (total)	Sb	μg/L	31	0.53	7	14%	0.15	n.d.	N/A	No	0.13		0.09	0.11	+0.004	0.09	0.11	No	Yes
Arsenic (total)	As	μg/L	53	0.5	10	30%	1.08	1.04	1.16	No	1.06		0.99	1.24	+0.03	1.02	1.27	No	Yes
Boron (total)	B	μg/L	500	100	8	0%	108	108	124	No	104		101.01	122	+2.50	104	124	No	Yes
Cadmium (total)	Cd	μg/L	2.5[10]	0.2	8	88%	0.09	n.d.	N/A	No	0.20	<	0.20	0.2	-0.01	0.19	0.19	No	Yes
Chromium (total)	Cr	μg/L	11[10]	1	8	38%	0.62	n.d.	N/A	No	0.81		0.58	0.95	+0.02	0.61	0.97	No	Yes
Cobalt (total)	Co	μg/L	5	0.2	8	0%	0.52	0.5	0.58	No	0.50		0.46	0.55	+0.02	0.48	0.57	No	Yes
Copper (total)	Cu	μg/L	9.3[10]	0.5	8	0%	3.24	3.17	3.65	No	3.28		3.35	4.01	-0.14	3.21	3.87	No	Yes
Lead (total)	Pb	μg/L	3.2[10]	0.5	8	25%	0.3	n.d.	N/A	No	0.41		0.27	0.41	-0.002	0.27	0.41	No	Yes
Nickel (total)	Ni	μg/L	52[10]	0.5	8	0%	3.95	3.64	419	No	3.82		3.63	4	-0.11	3.51	3.89	No	Yes
Selenium (total)	Se	μg/L	5	1	8	13%	0.66	n.d.	N/A	No	0.63		0.57	0.73	+0.05	0.63	0.78	No	Yes
Silver (total)	Ag	μg/L	1	0.2	8	50%	0.05	n.d.	N/A	No	0.11		0.006	0.007	+0.009	0.02	0.02	No	Yes
Thallium (total)	Tl	μg/L	0.56	0.005	7	100%	0.2	0.2	N/A	No	0.39	<	0.4	0.4	-0.02	0.38	0.38	Yes	No
Zinc (total)	Zn	μg/L	120[10]	6	16	0%	4.03	n.d.	N/A	No	4.50		4.16	4.97	+0.12	4.28	5.09	No	Yes
Chloride	Cl	mg/L	230	5	19	0%	7	7.1	7.8	No	6.6		4.91	5.68	+1.73	6.6	7.4	No	Yes
Hardness (as $CaCO_3$)		mg/L	500	10	10	0%	361	356	409	No	336		291	388	+40.2	331	428	No	Yes
pH		SU	6.5 to 8.5	0.01	11	0%	Not Available	7.66	N/A	Not Available	Not Available		7.61	7.71	+0.05	7.66	7.76	Not Available	Yes
Solids, total dissolved[12]		mg/L	700	10	10	0%	Not Available	452	N/A	Not Available	Not Available		375	490	+52.7	428	543	Not Available	Yes
Specific Conductance @ 25°C[13]		μS/cm	1,000	0	11	0%	Not Available	700	N/A	Not Available	Not Available		793	1173	+47.4	840	1220	Not Available	Yes
Sulfate	SO_4	mg/L	none[11]	1	10	0%	205	202	222	No	193		164	224	+26.1	190	250	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Estimated future water quality estimated with mass balance calculations

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit, and adjusted for flows from the LTVSMC pits that began after ther monitoring data was collected. (See Attachment E of the Antidegradation Evaluation for details)

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6 of the Antidegradation Evaluation.

(7) Alternative future water quality estimated with mass balance calculations based on central tendency in column N

(8) Central Tendency determined as described in Table 1.

(9) 95% UCL determined as described in Table 2.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

(14) Changes to load and flow from LTVSMC pits estimated from water quality data as described in Attachment C.

(15) Existing water quality central tendency plus the change due to LTVSMC pits.

(16) 95th percentile UCL plus the change due to LTVSMC pits.

(17) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(18) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

St. Louis River at USGS #04024000
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Conclusions and ProUCL results

							2016 Draft Antidegradation				ProUCL (Non-substitution methods)								
Parameter		Units	Applicable Standard[1]	Typical Reporting Limit (PQL)[2]	Number of Samples (n)	Percentage Non-Detect	2016 Draft Estimated Future Water Quality[3]	Existing Average Water Quality (substitution method)[4]	Upper LCS Limit[5]	Measurable Increase by LCS method?[6]	Alternative Estimated Future Water Quality[7]		Existing Water Quality Central Tendency[8]	95th Percentile UCL[9]	Estimated Change in Existing Central Tendency due to LTVSMC Pits[14]	Estimated Adjusted Central Tendency[15]	Estimated Adjusted 95th Percentile UCL[16]	Measurable Increase by UCL Method?[17]	LSC and UCL Measurable Increase Conclusion Same?
Aluminum (total)	Al	µg/L	125	2	50	2%	100	100	'--(18)	No	100.6		101	209	-0.41	100.6	208.6	No	Yes
Antimony (total)	Sb	µg/L	31	0.53	0		Not Available	Not Available	Not Available	Not Available	Not Available		Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Yes
Arsenic (total)	As	µg/L	53	0.5	67	34%	1.49	1.47	1.69	No	1.66		1.64	2.92	-0.001	1.64	2.92	No	Yes
Boron (total)	B	µg/L	500	100	91	0%	111	112	129	No	111		111	126	+0.09	112	126	No	Yes
Cadmium (total)	Cd	µg/L	2.5[10]	0.2	48	81%	1.36	1.36	1.56	No	1.00	<	1	1.67	-0.004	1.00	1.67	No	Yes
Chromium (total)	Cr	µg/L	11[10]	1	50	48%	6.42	6.4	7.36	No	6.25		6.26	10.8	-0.02	6.24	10.8	No	Yes
Cobalt (total)	Co	µg/L	5	0.2	52	96%	1.5	1.49	1.71	No	3.00	<	3	5	-0.01	2.99	4.99	No	Yes
Copper (total)	Cu	µg/L	9.3[10]	0.5	33	18%	7.53	7.5	8.63	No	7.44		7.44	22	-0.03	7.41	22.0	No	Yes
Lead (total)	Pb	µg/L	3.2[10]	0.5	34	79%	1.78	1.77	2.04	No	2.00	<	2	4	-0.01	1.99	3.99	No	Yes
Nickel (total)	Ni	µg/L	52[10]	0.5	39	56%	1.27	1.15	1.32	No	1.13	<	1	1.52	+0.01	1.01	1.53	No	Yes
Selenium (total)	Se	µg/L	5	1	73	96%	1	1	1.15	No	1.00	<	1	20	+0.001	1.00	20.0	No	Yes
Silver (total)	Ag	µg/L	1	0.2	53	98%	0.52	0.52	0.6	No	1.00	<	1	1	-0.004	1.00	1.00	No	Yes
Thallium (total)	Tl	µg/L	0.56	0.005	0		Not Available	Not Available	Not Available	Not Available	Not Available		Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Yes
Zinc (total)	Zn	µg/L	120[10]	6	55	18%	18.9	18.8	21.6	No	18.9		18.8	30.0	-0.06	18.7	29.9	No	Yes
Chloride	Cl	mg/L	230	5	387	0%	8.2	8.2	9	No	8.2		8.15	9.33	+0.08	8.2	9.4	No	Yes
Hardness (as $CaCO_3$)		mg/L	500	10	267	0%	78.7	80	92	No	78.5		76.7	78.8	+3.09	80	82	No	Yes
pH		SU	6.5 to 8.5	0.01	316	0%	Not Available	7.4	N/A	Not Available	Not Available		7.37	7.42	+0.004	7.38	7.42	Not Available	Yes
Solids, total dissolved[12]		mg/L	700	10	249	0%	Not Available	150	N/A	Not Available	Not Available		146	150	+3.82	150	154	Not Available	Yes
Specific Conductance @ 25°C[13]		µS/cm	1,000	0	319	0%	Not Available	189	N/A	Not Available	Not Available		183	188	+5.26	188	193	Not Available	Yes
Sulfate	SO_4	mg/L	none[11]	1	268	0%	19.1	19.7	21.7	No	19.5		18.1	18.3	+2.04	20.1	20.4	No	Yes

n.d. – All measured values are below reporting limits or the average value is below the reporting limit.

N/A – The concept of LCS acceptance range does not apply for parameters that have existing concentrations below the reporting limit.

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.

(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).

(3) Estimated future water quality estimated with mass balance calculations

(4) Average value of monitoring results, calculated using average values of duplicate samples and including results below analytic detection limits at half the value of the detection limit, and adjusted for flows from the LTVSMC pits that began after ther monitoring data was collected. (See Attachment E of the Antidegradation Evaluation for details)

(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of the measured value. See Section 5.6 of Antidegradation

(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6 of the Antidegradation Evaluation.

(7) Alternative future water quality estimated with mass balance calculations based on central tendency in column N

(8) Central Tendency determined as described in Table 1.

(9) 95% UCL determined as described in Table 2.

(10) Surface water quality standard is hardness dependent. The listed value assumes a hardness of 100 mg/L, which is the expected hardness of the WWTS discharge.

(11) The waterbody is not a listed wild rice water, so the sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable.

(12) Total dissolved solids based on mass sum of anticipated dissolved water quality parameters in assumed WWTS discharge (Table 3-2) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis.

(13) Specific conductance reflects an electrical characteristic of the water and cannot be calculated from chemical water quality data for mixed salt solutions. Specific conductance was estimated from the overall assumed WWTS discharge quality (Table 3-2) using several empirical methods (Section 4.5.2.1) and adjusted for uncertainty based on monitoring data (Appendix A). The maximum projected water quality was used for the antidegradation analysis

(14) Changes to load and flow from LTVSMC pits estimated from water quality data as described in Attachment E.

(15) Existing water quality central tendency plus the change due to LTVSMC pits.

(16) 95th percentile UCL plus the change due to LTVSMC pits.

(17) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.

(18) Measurable change was evaluated qualitatively because of the complex relationship between total and dissolved aluminum in Project area surface waters. See Section 6.3.4.2 of the Antidegradation Evaluation.

Mercury at all Stations
Existing and Estimated Mine Year 10 Water Quality in Receiving Waters
2016 Draft Antidegradation Evaluation and 95% UCLs

						2016 Draft Antidegradation				ProUCL (Non-substitution methods)		
Monitoring Station	Units	Applicable Standard(1)	Typical Reporting Limit (PQL)(2)	Number of Samples (n)	Percentage Non-Detect	Estimated Future Water Quality Mine Year 10 (3)	Existing Average Water Quality (KM mean)(4)	Upper LCS Limit(5)	Measurable Increase by LCS method?(6)	95th Percentile UCL(7)	Measurable Increase by UCL method?(8)	LSC and UCL Measurable Increase Conclusion Same?
MNSW12	ng/L	1.3	0.5	3	0%	4.7	4.7	5.7	No	9.5	No	Yes
MNSW8	ng/L	1.3	0.5	7	0%	4	4.0	4.9	No	5.6	No	Yes
PM-11	ng/L	1.3	0.5	38	16%	1.8	1.7	2.1	No	2.1	No	Yes
PM-13	ng/L	1.3	0.5	43	28%	3.4	3.4	4.2	No	4.2	No	Yes
SD026	ng/L	1.3	0.5	89	47%	1.3	0.6	0.7	Yes	0.7	Yes	Yes
SW004a	ng/L	1.3	0.5	19	0%	3.8	3.8	4.7	No	5.1	No	Yes
TC-1A	ng/L	1.3	0.5	12	0%	1.6	2.1	2.6	No	2.8	No	Yes
Forbes	ng/L	1.3	0.5	3	0%	4.1	4.1	5.1	No	8.9	No	Yes
Scanlon	ng/L	1.3	0.5	4	0%	4.6	4.6	5.7	No	9.4	No	Yes
Trimble Creek wetlands	ng/L	1.3	0.5	89	47%	1.3	2.1	2.6	No	2.8	No	Yes
Unnamed Creek Wetlands	ng/L	1.3	0.5	89	47%	1.3	1.7	2.1	No	2.1	No	Yes

(1) The most stringent applicable surface water quality standard; except, where a Minnesota Rule, chapter 7052 standard exists, it supersedes the Minnesota Rules, chapter 7050 standard(s), even if the Minnesota Rules, chapter 7052 standard is less stringent.
(2) The practical quantification limit (PQL), or reporting limit, is the lowest concentration that a laboratory can accurately measure (meeting US EPA criteria for laboratory accuracy and precision).
(3) Estimated using mass balance calculations
(4) Mean calculated using the Kaplan-Meier method
(5) Upper Laboratory Control Sample (LCS) limit is calculated from the existing average concentration, using the LCS acceptance criteria, which are a measure of the acceptable variability inherent in each EPA approved test method, expressed as a percentage of
(6) A measurable increase, using the LCS method, is defined as a value that is above the analytical reporting limit, and above the LCS acceptance range. See Section 5.6.
(8) 95% UCL determined as described in Table 2.
(9) A measurable increase, using the UCL method, is defined as a value that is above the analytical reporting limit, and above the 95% UCL.